THE AMERICAN ENCYCLOPEDIA AND DICTIONARY OF OPHTHALMOLOGY

EDITED BY

CASEY A. WOOD, M. D., C. M., D. C. L.

Professor of Ophthalmology and Head of the Department, College of Medicine, University of Illinois; Late Professor of Ophthalmology and Head of the Department, Northwestern University Medical School; Ex-President of the American Academy of Medicine, of the American Academy of Ophthalmology, and of the Chicago Ophthalmological Society; Ex-Chairman of the Ophthalmic Section of the American Medical Association; Editor of a "System of Ophthalmic Therapeutics" and a "System of Ophthalmic Operations"; Mitglied der Ophthalmologischen Gesellschaft, etc.; Ophthalmic Surgeon to St. Luke's Hospital; Consulting Ophthalmologist to Cook County Hospital, Chicago, Ill.

ASSISTED BY A LARGE STAFF OF COLLABORATORS

FULLY ILLUSTRATED

Volume IX—Institutions for the Blind to Lemotes

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INITIALS USED IN THIS ENCYCLOPEDIA TO IDENTIFY INDIVIDUAL CONTRIBUTORS

A. A.—Adolf Alt, M. D., M. C. P. and S. O., St. Louis, Mo.
Clinical Professor of Ophthalmology, Washington University, St. Louis, Mo.; Author of *Lectures on The Human Eye; Treatise on Ophthalmology for the General Practitioner; Original Contributions Concerning the Glandular Structures Appertaining to the Human Eye and its Appendages.* Editor of the *American Journal of Ophthalmology.*

A. C. C.—Alfred C. Croftan, Ph. D., M. D., Chicago, Ill.
Author of *Clinical Urinology* and of *Clinical Therapeutics.* Member of the General Staff of the Michael Reese Hospital, Chicago. Formerly Physician-in-chief at St. Mary's Hospital; Physician to St. Elizabeth's Hospital; Physician to the Chicago Post-Graduate Hospital; Pathologist to St. Luke's Hospital. Late Professor of Medicine at the Chicago Post-Graduate College and the Chicago Polyclinic; Assistant Professor of Clinical Medicine, College of Physicians and Surgeons (University of Illinois); Member of the American Therapeutic Society.

A. E. B.—Albert Eugene Bulson, Jr., B. S., M. D., Fort Wayne, Ind.
Professor of Ophthalmology, Indiana University School of Medicine; Chairman of the Section on Ophthalmology of the American Medical Association; Ophthalmologist to St. Joseph's Hospital, Allen County Orphans' Home, and the United States Pension Department; Editor of the *Journal of the Indiana State Medical Association,* etc.

A. E. H.—Albert E. Halstead, M. D., Chicago, Ill.
Professor of Clinical Surgery, Northwestern University Medical School; Attending Surgeon, St. Luke's and Cook County Hospitals, Chicago; Consulting Surgeon, Illinois Charitable Eye and Ear Infirmary; Fellow American Surgical Association.

A. N. M.—Alfred Nicholas Murray, M. D., Chicago, Ill.
Ophthalmologist, New Lake View Hospital. Formerly Clinical Assistant in Ophthalmology, and Assistant Secretary of the Faculty, Rush Medical College. Once Voluntary Assistant in the Universitaets Augenklinik, Breslau. Author of *Minor Ophthalmic and Aural Technique.* Secretary, Physicians' Club of Chicago. Mitglied der Ophthalmologischen Gesellschaft, Heidelberg.

A. S. R.—Alexander Sands Rochester, M. D., Chicago, Ill.
M. D. Jefferson Medical College; Ex-Chief, San Lazaro Contagious Hospital, Manila, P. I.; Adjunct Ophthalmologist to St. Luke's Hospital, Chicago.

B. C.—Burton Chance, M. D., Philadelphia, Pa.
Assistant Surgeon, Wills Hospital, Philadelphia.

C. A. O.—Charles A. Oliver (Deceased).

C. D. C.—Carl Dudley Camp, M. D., Ann Arbor, Mich.
Clinical Professor of Diseases of the Nervous System in the Medical Department of the University of Michigan. Formerly, Instructor in Neuropathology in the University of Pennsylvania. Member of the American Neurological Association, American Association of Pathologists and Bacteriologists, American Therapeutic Society, American Medical Association, etc. Author of papers on the Anatomy, Physiology and Pathology of the Nervous System.

C. E. W.—Lieut.-Col. Charles E. Woodruff, M. D., U. S. Army, Retired.

C. F. F. C.—Charles F. F. Campbell, Columbus, Ohio.

Superintendent Ohio State School for the Blind; Secretary Ohio State Commission for the Blind; Secretary, American Association of Workers for the Blind; Founder and Editor, "*Outlook for the Blind;*" Previously executive officer of the Massachusetts Association for Promoting the Interests of the Blind, Massachusetts State Commission for the Blind, and Pennsylvania Association for the Blind; At one time Teacher at the Royal Normal College and Academy of Music, for the Blind, London, England.

C. F. P.—Charles F. Prentice, M. E., New York City, N. Y.

President, New York State Board of Examiners in Optometry; Special Lecturer on Theoretic Optometry, Columbia University, New York. Author of *A Treatise on Ophthalmic Lenses* (1886); *Dioptric Formulæ for Combined Cylindrical Lenses* (1888); *A Metric System of Numbering and Measuring Prisms (the Prism-dioptry)* (1890); *The Iris as Diaphragm and Photostat* (1895), and other optical papers.

C. H. B.—Charles Heady Beard, M. D. (Deceased).

C. P. S.—Charles P. Small, A. M., M. D., Chicago, Ill.

Late Clinical Assistant, Department of Ophthalmology, Rush Medical College. Author of *A Probable Metastatic Hypernephroma of the Choroid.*

D. C. Mc.—Douglas C. McMurtrie, New York City.

Editor *American Journal of Care for Cripples;* former Secretary, American Association for the Conservation of Vision; Author of *Education of and Occupations for the Blind* in the *Reference Handbook of the Medical Sciences.*

D. H.—D'Orsay Hecht, M. D. (Deceased).

D. W. G.—Duff Warren Greene, M. A., M. S., M. D. (Deceased).

E. C. B.—Edward C. Bull, Pasadena, Calif.

E. C. E.—Edward Coleman Ellett, B. A., M. D., Memphis, Tenn.

Professor of Ophthalmology, University of Tennessee, College of Medicine.

E. E. I.—Ernest E. Irons, M. D., Ph. D., Chicago, Ill.

Assistant Professor of Medicine, Rush Medical College; Assistant Attending Physician, Presbyterian Hospital; Attending Physician, Cook County Hospital; Consulting Physician, Durand Hospital of the Memorial Institute for Infectious Diseases, Chicago.

E. H.—Emory Hill, A. B., M. D., Chicago, Ill.

Late House Surgeon, Wills Eye Hospital, Philadelphia; Assistant in Ophthalmology, Rush Medical College (in affiliation with the University of Chicago); Assistant Ophthalmologist to the out-patient department of the Children's Memorial Hospital, Chicago; Assistant Instructor in Ophthalmology, Chicago Polyclinic. Member of American Academy of Ophthalmology and Oto-Laryngology.

E. J.—Edward Jackson, C. E., M. A., M. D., Denver, Colo.

Professor of Ophthalmology in the University of Colorado; Former Chairman of the Section on Ophthalmology of the American Medical Association; Former President of the American Academy of Ophthalmology and Oto-Laryngology; The American Ophthalmological Society, and The American Academy of Medicine. Author of *Skiascopy and its Practical Application; Manual of Diseases of the Eye;* Editor of *Ophthalmic Year-Book* (nine volumes); *Ophthalmic Review; Ophthalmic Record;* and *Ophthalmic Literature.*

E. K. F.—Ephraim Kirkpatrick Findlay, M. D., C. M., Chicago, Ill.

Assistant Clinical Professor of Ophthalmology, Medical Department, University

of Illinois; Assistant Surgeon of the Illinois Charitable Eye and Ear Infirmary; Assistant Oculist at the University Hospital.

E. S. T.—Edgar Steiner Thomson, M. D., New York City, N. Y.

Surgeon and Pathologist, Manhattan Eye, Ear and Throat Hospital; Professor of Ophthalmology, New York Polyclinic Medical School and Hospital; Consulting Ophthalmologist to Perth Amboy and Ossining Hospitals; Member of the New York Academy of Medicine, New York Ophthalmological, and American Ophthalmological Societies. Author of *Electric Appliances and Their Use in Ophthalmic Surgery,* in Wood's *System of Ophthalmic Operations,* and various monographs.

F. A.—Frank Allport, M. D., LL. D., Chicago, Ill.

Ex-Professor, Ophthalmology and Otology, Minnesota State University; Ex-President, Minnesota State Medical Society; Ex-Chairman and Secretary, Ophthalmic Section, American Medical Association; Ex-Professor, Ophthalmology and Otology, Northwestern University Medical School; Ex-President, Chicago Ophthalmological Society. Author of *The Eye and Its Care;* Co-Author of *An American Text-Book of Diseases of the Eye, Ear, Nose and Throat; A System of Ophthalmic Therapeutics,* and *A System of Ophthalmic Operations.* Eye and Ear Surgeon to the Chicago Board of Education and to St. Luke's Hospital, Chicago.

F. C. T.—Frank C. Todd, D. D. S., M. D., F. A. C. S., Minneapolis, Minn.

Professor of Ophthalmology and Chief of the Division of Eye, Ear, Nose and Throat, University of Minnesota, Medical Department; Chief of Eye, Ear, Nose and Throat Staff, University of Minnesota Hospitals; Eye, Ear, Nose and Throat Surgeon to Hill Crest Hospital; Eye Surgeon to the C. M. & St. P. R. R. Co., etc.; Chairman of the Section of Ophthalmology, A. M. A.; President of the Minnesota Academy of Ophthalmology and Oto-Laryngology; Vice-President of the A. M. A., etc. Monographs: *An Exact and Secure Tucking Operation for Advancing an Ocular Muscle; A Method of Performing Tenotomy which Enables the Operator to Limit the Effect as Required; Mules' Operation; Keratectasia; Report of a Case with Transparent Cornea; The Implantation of an Artificial Vitreous as a Substitute for Enucleation of the Eyeball; Simple Method of Suturing the Tendons in Enucleation; Malingering (Pretended Blindness); The Physiological and Pathological Pupil.*

F. E. B.—Frank E. Brawley, Ph. G., M. D., Chicago, Ill.

Co-Author of *Commoner Diseases of the Eye, A System of Ophthalmic Therapeutics* and *A System of Ophthalmic Operations;* formerly voluntary assistant in the Universitaets Augenklinik, Breslau, and the Royal London Ophthalmic Hospital (Moorfields); Oculist and Aurist to St. Luke's Hospital, Chicago. Editorial Secretary of *The Ophthalmic Record.*

F. P. L.—Francis Park Lewis, M. D., Buffalo, N. Y.

President American Association for the Conservation of Vision; President Board of Trustees N. Y. State School for the Blind; President N. Y. State Commissions for the Blind (1903 and 1906); Chairman Committee on Prevention of Blindness, American Medical Association; Ophthalmologist Buffalo State Hospital and Buffalo Homeopathic Hospital; Consulting Ophthalmologist J. N. Adam Memorial Hospital; Fellow Academy Ophthalmology and Oto-Laryngology.

G. C. C.—See *G. C. S.*

G. C. S.—G. C. Savage, M. D., Nashville, Tenn.

Professor of Ophthalmology in the Medical Department of Vanderbilt University; Ex-President of the Nashville Academy of Medicine; Ex-President of the Tennessee State Medical Society. Author of *New Truths in Ophthalmology* and *Ophthalmic Myology.*

G. F. L.—George Franklin Libby, M. D., Oph. D., Denver, Colorado.
Ex-Assistant Surgeon to the Maine Eye and Ear Infirmary; Ophthalmologist to National Jewish Hospital for Consumptives, Mercy Hospital, and Children's Hospital, Denver; and Denver, Laramie and North Western Railroad; Member of the American Ophthalmological Society, Academy of Ophthalmology and Oto-Laryngology, and Colorado Ophthalmological Society (its Secretary for six years); Author of *Monocular Blindness of Fifty Years' Duration: Restoration of Vision Following Hemiplegia; Polyps in the Lower Canaliculus; Silver Salts in Ocular Therapeutics; Ocular Disease in Relation to Nasal Obstruction and Empyema of the Accessory Sinuses (Bibl.); A Case of Complete Albinism: Observations on the Changes in the Diameters of the Lens as Seen through the Iris; Consanguinity in Relation to Ocular Disease; Heredity in Relation to the Eye (doctorate thesis, Univ. of Colo., 1913); Acquired Symmetrical Opacities of the Cornea of Unusual Type; Tuberculosis of the Bulbar Conjunctiva*, etc.

H. B. C.—H. Beckles Chandler, C. M., M. D., Boston, Mass.
Professor Ophthalmology, Tufts Medical School, Boston; Senior Surgeon Massachusetts Charitable Eye and Ear Infirmary.

H. B. W.—Henry Baldwin Ward, A. B., A. M., Ph. D., Champaign, Ill.
Professor of Zoology, University of Illinois; Ex-Dean of the College of Medicine, University of Nebraska. Author of *Parasitic Worms of Man and the Domestic Animals; Data for the Determination of Human Entozoa; Iconographia Parasitorum Hominis; Human Parasites in North America.*

H. F. H.—Howard F. Hansell, A. M., M. D., Philadelphia, Pa.
Professor of Ophthalmology, Jefferson Medical College; Emeritus Professor Diseases of the Eye, Philadelphia Polyclinic Hospital; Ophthalmologist to Jefferson Medical College Hospital; Ophthalmologist to Philadelphia Hospital.

H. G. L.—Henry Glover Langworthy, M. D., Dubuque, Iowa.
Surgeon to the Langworthy Eye, Ear, Nose and Throat Infirmary, Dubuque, Iowa; Member American Academy of Ophthalmology and Oto-Laryngology; of the Chicago Ophthalmological Society; of the American Medical Association, etc. Writer of numerous monographs on the special subjects of eye, ear, nose and throat.

H. S. G.—Harry Searls Gradle, A. B., M. D., Chicago, Ill.
Professor of Ophthalmology, Chicago Eye and Ear College; Director of Ophthalmic Clinic, West Side Free Dispensary; Member of the Ophthalmologische Gesellschaft, American Medical Association, American Academy of Ophthalmology and Oto-Laryngology.

H. V. W.—Harry Vanderbilt Würdemann, M. D., Seattle, Wash.
Managing Editor, *Ophthalmology*, since 1904; Editorial Staff of the *Ophthalmic Record* since 1897; Managing Editor, *Annals of Ophthalmology*, 1897-1904. Member American Medical Association; Ex-Chairman Section on Ophthalmology, American Medical Association; Hon. Member, Sociedad Cientifica, Mexico; N. W. Wisconsin Medical Society and Philosophical Society. Fellow American Academy of Ophthalmology and Oto-Laryngology. Author of *Visual Economics* (1901); *Injuries to the Eye* (1912); *Bright's Disease and the Eye* (1912); and numerous monographs on the eye and its diseases. Collaborator on many other scientific books.

J. D. L.—Joseph D. Lewis, A. M., M. D., Minneapolis, Minn.
Ophthalmic and Aural Surgeon to the Minneapolis City Hospital; Consulting Ophthalmic and Aural Surgeon to Hopewell Hospital and Visiting Nurses' Association; Member Minnesota Academy of Ophthalmology and Oto-Laryngology; Fellow American College of Surgeons.

J. G., Jr.—John Green, Jr., A. B., M. D., St. Louis, Mo.

Assistant in Ophthalmology, Washington University Medical School; Ophthalmic Surgeon to St. Louis Children's Hospital; Ophthalmic Surgeon to St. Louis Eye, Ear, Nose and Throat Infirmary; Consulting Ophthalmic Surgeon to St. Louis Maternity Hospital; Consulting Ophthalmic Surgeon to St. John's Hospital, St. Louis.

J. L. M.—John L. Moffat, B. S., M. D., O. et A. Chir., Ithaca, N. Y.

Editor *Journal of Ophthalmology, Otology and Laryngology.* Consulting Ophthalmic Surgeon, Cumberland Street Hospital, New York; Member (v.-p. 1905, 1908) American Homœopathic Ophthalmological, Otological and Laryngological Society; Member American Medical Editors' Association; Member (Senior) American Institute of Homœopathy; Senior Member (ex-pres.) New York State Homœopathic Medical Society; Senior Member (ex-pres.) Kings County (N. Y.) Homœopathic Medical Society; Honorary Member N. Y. County Homœopathic Medical Society.

J. M. B.—James Moores Ball, M. D., LL. D., St. Louis, Mo.

Dean and Professor of Ophthalmology, American Medical College of St. Louis, Medical Department of National University of Arts and Sciences. Author of *Modern Ophthalmology; Andreas Vesalius the Reformer of Anatomy.*

J. R. C.—James Raley Cravath, B. S., Chicago, Ill.

Electrical and Illuminating Engineer, Chicago; Vice-President, Illuminating Engineering Society; formerly associate editor *Electrical World;* joint author *Practical Illumination* by Cravath and Lansingh; joint author *Light—Its Use and Misuse,* prepared by committee of the Illuminating Engineering Society; author of *Illumination and Vision; Tests of the Lighting of a Small Room;* and numerous other monographs.

L. H.—Lucien Howe, M. A., M. D., Sc. D., Buffalo, N. Y.

Professor of Ophthalmology, University of Buffalo; Member of the Royal College of Surgeons of England; Fellow of the Royal Society of Medicine; Member of the *Ophthalmologische Gesellschaft* and of the *Société Française d'Ophthalmologie.* Author of *The Muscles of the Eye.*

M. S.—Myles Standish, A. M., M. D., S. D., Boston, Mass.

Williams Professor of Ophthalmology, Harvard University; Consulting Ophthalmic Surgeon, Massachusetts Charitable Eye and Ear Infirmary and Carney Hospital, Boston, Mass.

N. M. B.—Nelson M. Black, Ph. G., M. D., Milwaukee, Wis.

Author of *The Development of the Fusion Center in the Treatment of Strabismus; Examination of the Eyes of Transportation Employes; Artificial Illumination a Factor in Ocular Discomfort,* and other scientific papers.

P. A. C.—Peter A. Callan, M. D., New York City, N. Y.

Surgeon, New York Eye and Ear Infirmary; Ophthalmologist to St. Vincent's Hospital; Columbus Hospital and St. Joseph's Hospital, New York.

P. G.—Paul Guilford, M. D., Chicago, Ill.

Ex-Resident Surgeon, Wills Eye Hospital, Philadelphia; Attending Oculist and Aurist, St. Luke's Hospital; Attending Oculist and Aurist, Chicago Orphan Asylum; Consulting Oculist and Aurist, South Side Free Dispensary. Co-Author of *A System of Ophthalmic Operations.*

R. D. P.—Robert D. Pettet, Chicago, Ill.

Author of *The Mechanics of Fitting Glasses.*

S. H. McK.—Samuel Hanford McKee, B. A., M. D., Montreal, Que.

Lecturer in Pathology and Bacteriology, McGill University; Demonstrator in Ophthalmology, McGill University; Assistant Oculist and Aurist to the Montreal General Hospital; Oculist to the Montreal Maternity Hospital; Oculist to

the Alexandra Hospital; Member of The American Association of Pathologists and Bacteriologists. Author of *The Bacteriology of Conjunctivitis; An Analysis of Three Hundred Cases of Morax-Axenfeld Conjunctivitis; Demonstration of the Spirocheta Pallida from a Mucous Patch of the Conjunctiva; The Pathological Histology of Trachoma,* and numerous other monographs.

T. A. W.—THOMAS A. WOODRUFF, M. D., C. M., L. R. C. P.

Ex-President of Chicago Ophthalmological Society; Vice-President of the Illinois Society for the Prevention of Blindness; Fellow of A. M. A.; Fellow American Academy of Medicine; Fellow of American Academy of Ophthalmology; Formerly Editorial Secretary of the *Ophthalmic Record;* Fellow American College of Surgeons; Fellow of the Institute of Medicine of Chicago; Member of Chicago Society of Medical History; Chicago Medical Society; Author with Casey A. Wood of *Commoner Diseases of the Eye;* Formerly Ophthalmic Surgeon to St. Luke's Hospital.

T. H. S.—THOMAS HALL SHASTID, A. B., A. M., M. D., LL. B., F. A. C. S., SUPERIOR, WIS.

Honorary Professor of the History of Medicine in the American Medical College, St. Louis, Mo.; Late Editorial Secretary of *The Ophthalmic Record,* Author of *A Country Doctor; Practising in Pike; Forensic Relations of Ophthalmic Surgery* (in Wood's *System of Ophthalmic Operations); Legal Relations of Ophthalmology* (in Ball's *Modern Ophthalmology); A History of Medical Jurisprudence in America* (in Kelly's *Cyclopedia of American Medical Biography).*

W. C. P.—WM. CAMPBELL POSEY, B. A., M. D., PHILADELPHIA, PA.

Professor of Ophthalmology in the Philadelphia Polyclinic Hospital and Graduate Medical School; Ophthalmic Surgeon to the Wills, Howard and Children's Hospitals; Chairman of the Pennsylvania Commission for the Conservation of Vision; Chairman of Section on Ophthalmology, College of Physicians, Philadelphia. Editor of American Edition of Nettleship's *Textbook of Ophthalmology;* Co-Editor, with Jonathan Wright, of *System of Diseases of the Eye, Ear, Nose and Throat;* Co-Editor, with Wm. G. Spiller, of *The Eye and the Nervous System.*

W. F. C.—W. FRANKLIN COLEMAN, M. D., M. R. C. S. ENG., CHICAGO, ILL.

Professor of Ophthalmology Post-Graduate Medical School; Professor of Ophthalmology Illinois School Electro-Therapeutics; Member Chicago Ophthalmological Society.

W. F. H.—WILLIAM FREDERIC HARDY, M. D., ST. LOUIS, MO.

Assistant in Ophthalmology, Washington University Medical School.

W. H. W.—WILLIAM HAMLIN WILDER, A. M., M. D., CHICAGO, ILL.

Professor and Head of Department of Ophthalmology, Rush Medical College (in affiliation with University of Chicago); Professor of Ophthalmology, Chicago Polyclinic; Surgeon, Illinois Charitable Eye and Ear Infirmary; Ophthalmic Surgeon, Presbyterian Hospital; Member American Ophthalmological Society.

W. O. N.—WILLIS ORVILLE NANCE, M. D., CHICAGO, ILL.

Ophthalmic Surgeon, Illinois Charitable Eye and Ear Infirmary; Late Oculist and Aurist to Cook County Hospital; President, Chicago Ophthalmological Society.

W. R.—WENDELL REBER, M. D., PHILADELPHIA, PA.

Professor of Diseases of the Eye in the Medical Department of Temple University; Professor of Diseases of the Eye in the Philadelphia Polyclinic and College for Graduates in Medicine; Ophthalmic Surgeon to the Samaritan Hospital, to the Philadelphia General Hospital, to the Garretson Hospital; Consulting Ophthalmologist to the Friends' Asylum for the Insane; Member of the Council of the Oxford Ophthalmological Congress; Past President of the American Academy of Ophthalmology and Oto-Laryngology; joint author of a *Handbook on the Muscular Anomalies of the Eye.*

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Institutions for the blind (continued). (C.) AMERICAN INSTITUTIONS, SCHOOLS AND OTHER RESOURCES FOR THE BLIND.

Probably every ophthalmologist has, at some time or other, been asked where and how a blind person can be schooled or otherwise armed for the battle of life. In the following survey, we have endeavored to make it possible for an inquirer in any one of the United States, or provinces of Canada, by referring to this section of the *Encyclopedia,* to find just what are the resources for the blind in his own locality.

We have deliberately refrained from lengthy statements with regard to the education and training of the blind on this continent in the belief that the accompanying series of illustrations with their captions will be more effective than many words. It will be observed, starting with the care of infants, as exemplified in a nursery for blind babies and ending with assistance for adults, that we show with these pictures practically every phase of work for and by the blind in America. The illustrations are typical of the best work in the country.

By referring to the sub-sections dealing with one's own state or province there will be found the agencies in that locality available for the blind. If there is no institution or organization in a particular commonwealth applicable to the particular needs of the person in whom one may be interested, apply to the superintendent of the existing institution. He will be glad to direct the applicant to the nearest source of help.

Historical sketch. In the United States the first attempt to be of service to the blind was made in behalf of the education of blind children, as few of the handicapped make a stronger appeal than the blind child. The first schools were started in the eastern states; Boston, New York, and Philadelphia opening them in the early thirties. It matters little which of these institutions actually began teaching blind children first. Suffice it to say that by 1835 the work was well under way in each of these cities, and, as so frequently the custom with pioneer work of an educational and philanthropic nature, the maintenance of these institutions was secured from public-spirited individuals. It was not long, however, before appeals were made to the legislatures, and state aid was soon forthcoming for the education of blind children, not only in the three above mentioned cities, but in other parts of the country. The dates of the founding of the various schools are given as the facts about each institution are recorded.

Almost all those who began working for blind children sooner or later were confronted with the problem of blind adults; not only

children who grew up into adults, but also those who lost their sight later in life. Very naturally those who were responsible for the management of early institutions for the education of the blind youth, felt it incumbent upon them to do what they could for blind adults, with the result that in most of the earlier schools for the blind in the United States small workshops or departments were maintained for the instruction and employment of blind men and women.

It was soon recognized by educators of the blind that it was unwise to have adults mingle with children, so that gradually the department for adults was separated from the rest of the institution, and almost all of the state schools for the blind were devoted principally to the education of blind youth.

Strange as it may seem, no general movement swept over the country during the nineteenth century for the training and care of the adult blind, such as manifested itself for the education of blind children. There were, however, notable exceptions in several states of which mention ought to be made. Dr. Samuel Gridley Howe, who is recognized by all as the pioneer worker for the blind in America, established a workshop for blind adults in 1848, which was in reality an off-shoot from the older educational institution for blind children. This shop, in which mattress-making and chair-caning are the principal industries, is still in existence.

The New York City and Maryland schools for the blind spent considerable money in efforts to operate industrial establishments for blind adults, and the Maryland school shop, continued to the present day, has become the Maryland Workshop for the Blind. The department for adults of the New York Institute was not continued, but in 1869 the Society for the Relief of the Destitute Blind of New York City opened a home which is now located at 104th Street and Amsterdam Avenue. In 1868 and 1874 respectively, a working home for blind women and a working home for blind men were established in Philadelphia. While these institutions were not the direct outgrowth of departments of the Philadelphia School for the Blind, the management of the school was very much interested in having practical work undertaken for the adult blind.

The first home teaching society to be established in America was founded in Philadelphia by Dr. Moon, the creator of the Moon alphabet (See p. 259, Vol. I, of this *Encyclopedia.*) for the blind, and was conducted along the general lines pursued by the English Home Teaching Societies. The Pennsylvania Home Teaching Society did not expand to any great extent during the first years of its existence, and confined most of its efforts to Philadelphia. In 1892 a movement

Photo from the Perkins Institution. Watertown, Mass.

Playing with the Sand in the Courtyard of the Kindergarten of the Perkins Institution. The first kindergarten for blind children in America was started at the Perkins Institution and Massachusetts School for the Blind.

was set on foot in Connecticut which resulted in the establishment of the Institute for the Blind of that state, and started a wave of interest in adults that soon reached Massachusetts, where instruction for blind adults in their homes was first provided at state expense in 1900.

With the opening of the twentieth century, we find the beginning of an ever increasing effort to provide adequately for the care of the adult blind. In 1903 the first of many associations for the blind was started in Massachusetts. It was also in 1903 that the legislatures of both Massachusetts and New York appointed temporary commissions, which were directed to investigate the condition and needs of the blind in their respective states. In 1906, the temporary commission of Massachusetts was followed by the appointment of the first permanent State Commission for the Blind in the United States. Almost every year since has witnessed in one or more states the beginning of some kind of state supported work for blind adults, and also for the prevention of blindness.

Even before this section is printed new activities for the blind will undoubtedly be undertaken in different parts of the country. Information about these more recent endeavors can be found in the *Outlook for the Blind,* published in Columbus, Ohio, the official organ of the American Association of Instructors of the Blind and the American Association of Workers for the Blind, the two national organizations of this country devoted to the interests of the blind.

With the exception of a few of the older eastern schools for the blind, every institution for the education of blind children is supported at public expense. Even the schools which have private endowments receive more or less state aid. The requirements for admission, the course and term of instruction and the general plan of work in every school for the blind in the United States are so similar that, instead of repeating the same item under each school, we give an outline of the work in a typical school for the blind. When referring to the individual institutions, we call attention to special features in which they differ from this "typical school."

As with residential schools, so with the training of blind children in the public schools; the plan is exactly the same in all of the cities in which blind children attend public schools. We, therefore, give a brief sketch of the method followed for training such children, and, as above indicated, will not repeat this statement for the various cities in which such work is being done.

Commissions, associations, libraries, and pensions for the blind likewise have fundamental underlying principles which are common

to all of them, and we give what might be termed the objects of these in the following general statement. See, in this connection, the various **Blind** as well as **Blindness** captions beginning with p. 116, Vol. II, of this *Encyclopedia;* also **Alphabets and literature for the blind,** p. 249, Vol. I.

RESIDENTIAL SCHOOLS FOR THE BLIND.

These schools are, generally speaking, open to all blind children of the state who are mentally normal and are at least five years of age, and not over twenty. There is some slight variation in these age limits, but the precise requirements of each institution will be furnished upon application. The vision of applicants must be too defective to permit them to follow the usual methods adopted in public schools for the education of those who see. The course of instruction is very similar to that given in the public schools. It should be noted, however, that inasmuch as considerable additional time has to be devoted to either professional or trade training during the closing years of the student's term, the upper grades in some of the schools do not entirely approximate similar grades in the public schools. Every school for the blind has a more or less full course in musical education for those who are qualified to benefit by the same. Vocal, pianoforte, and, in many schools, organ instruction is provided, and, in a limited number, training is given upon orchestral instruments, and sometimes there is a voluntary band. Every school gives a course in piano-tuning and repairing, and many schools have recently purchased the "actions" of various piano players so that prospective tuners may have experience with this increasingly popular instrument. Practically every school gives training in various trades, those most usually found being broom, basket, and mattress making, rag carpet and art fabric weaving, and re-seating of chairs. Girls are all taught hand and machine sewing, crocheting and knitting, and in most schools are given a more or less extensive course in domestic science. In all the schools physical training is given. A number of schools have removed from crowded city premises to sites in the country where ample playgrounds are provided.

We are unable to give any satisfactory average number of years that pupils attend state schools. Students are usually allowed to remain as long as the school is able to give them any real help.

It cannot be too emphatically emphasized that these institutions are not "Homes" or "Asylums" to which blind children can be sent for permanent custodial care, but *boarding schools* for those who have been so unfortunate as to lose their sight. Every child leaves the school during the long summer vacation. It should also be men-

Photo from the School for the Blind, Pittsburgh, Pa.

Special Buildings for Housing Children of Kindergarten Age are to be Found in an Ever Increasing Number of Schools for the Blind.

Photo from the School for the Blind, Philadelphia, Pa.

The Connecting Class in the Primary Department at the Kindergarten Building.

The first and the third child (counting from the left) are reading with their fingers. The second boy is writing the raised dot characters and the fourth pupil is a beginner learning the raised dot characters by means of a "peg board" in which are small holes, arranged precisely like the cells in the guide of the slate which the second lad is using.

tioned that parents or guardians have to provide clothing for the children during their education. The aim of every school for the blind in this country is to fit the students for life, that they may become wholly, or in part, self-supporting, and take their places in the community as respected and self-respecting citizens. There are a few states which have not, as yet, schools of their own; they make appropriations so that their blind children can be sent to schools in neighboring states. So general is this provision that every normal blind child in North America can secure, free of expense, an excellent education and training. No other country in the world makes such liberal provision for the education of its blind youth, mostly at the expense of the state.

Alumni associations. Most schools for the blind have alumni associations which meet more or less frequently. Some of the organizations have been very active and have played a prominent part in fostering progressive movements in behalf of the blind, not only for graduates of the institutions they represented, but also for men and women blinded in adult life.

CO-EDUCATION OF THE BLIND, THE SEMI-BLIND, AND THE SEEING IN PUBLIC SCHOOLS.

The first attempt in America to educate blind children side by side with those who see was made in Chicago. This method of educating the blind had been begun more than half a century ago in Paisley, Scotland, and in London, England. In passing, however, it should be mentioned that the plan in England later resolved itself into what might be termed "day school centers" for blind children, to which the pupils were brought from their surrounding homes day by day but were not placed in classes with their seeing companions, as is the characteristic feature of the present American plan.

The Chicago or, as it is more generally known, "the day school plan," is as follows: A group of children, usually not more than ten, come to one of the public schools in the neighborhood of their homes. This group of blind children is assigned to a special teacher, and to a special room. The children may be of all ages, and therefore of various grades in scholarship. The first duty of the instructor is to train the pupils to make use of the devices used by the blind to enable them to interpret with their fingers the text-books used by the seeing. As soon as a blind child is able to use these devices with sufficient accuracy and speed, he then goes into the class-room of seeing children of about the same age, and takes part with his seeing companions in the regular school work. If the class happens to be reading, the blind

child produces his raised type copy of the book used by his seeing companions and takes his turn in the same way as does his sighted classmate. The younger blind children write their compositions in raised dots. These are later transcribed by the special teacher and passed on to the grade teacher for correction with the papers prepared by the seeing children. Older blind children prepare their work on the typewriter and hand it to the teacher of the grade room in which they are enrolled.

It will be recognized immediately that this method of education is only available in cities where there are at least ten or more blind children. As the population of this country is very scattered, there always will be a need for a centrally located residential state institution. Furthermore, "the day school plan" has been in operation too short a time for one to make any general assertion as to its ultimate or comparative success or failure. The points in its favor are economy, normal home life and association and immediate and constant competition with the seeing. The greatest problem confronting those responsible for this method of education is how to provide for the student's professional or trade training. Progressive and broad-minded superintendents of residential schools for the blind do not look upon "the day school plan" as a competitive method of educating the blind. but rather as a plan which calls for the heartiest cooperation. By a well-balanced and practical working together of the supervisors of blind children in both residential and day schools the best results can unquestionably be secured.

There is one development of the day school work which should receive special mention. A number of cities, notably Boston, Cleveland, Cincinnati, Toledo, and New York, have made special provision for children with defective eyesight who are not usually considered blind. These pupils have sufficient vision to enable them to do a limited amount of reading of ordinary print, but their defective sight handicaps them in attempting the work of the regular class-room. Special rooms having as nearly ideal lighting conditions as can be found have been set aside for these partially-blind children.

The method of instruction followed makes a judicious use of what vision these pupils possess, but great care is exercised not to overtax their weak eyes. Much of the written work is done on the blackboard, though some pupils are permitted to use a soft pencil, writing in very large letters upon unglazed paper. Liberal use is also made of the typewriter. Text books in large print have been prepared for use in these classes. The pupils attend the grade rooms in the building,

for such work as they can do orally or in a way not to strain their eyes.

In Cleveland, where this work has been most thoroughly organized, no reasonable expenditure of money necessary to bring the work of these classes up to the highest efficiency has been spared. Here it has been found that children needing the assistance of such special classes outnumber to a marked degree the children who are totally blind.

COMMISSIONS FOR THE BLIND.

Organizations committed to the interests of the blind, whether maintained by state or private funds, follow the same general plan, and as we have given the fundamentals of a typical school for the blind, it seems desirable to indicate what activities are carried on by the organizations concerned with the welfare of the adult blind. These commissions might be said to concern themselves with all the blind who lose their sight too late to be admitted to schools for blind youth, and also with the prevention of unnecessary blindness. The Massachusetts Commission, which may fairly be said to be the forerunner of much of the work for the adult blind, summarize their activities as follows: 1. Maintenance of bureau of information and advice. 2. Industrial training of blind adults. 3. Employment of blind men and women in shops and in their own homes; also through salesroom and special sales. 4. Fostering of home industries by loans, equipment, etc. 5. Reporting to other agencies for schooling, medical care, relief, recreation, etc. 6. Acquainting the public with the capabilities of the blind. 7. Promoting non-medical work for prevention of blindness and conservation of eyesight.

In each state where work for the adult blind is being undertaken it will be found that some, or all, of the before mentioned activities are being carried on, and in almost every instance some form of home instruction is being given.

In conclusion, it should be said that all organizations for the adult blind, whether supported by state or by private funds, make a great effort to solve the problem, as far as possible, of each *individual* blind person. The circumstances connected with each case are given the most careful consideration, and an effort is made to adjust that person, in spite of his blindness, to a life of usefulness and contentment.

ASSOCIATIONS FOR THE BLIND.

In a general way, it may be said that associations for the blind attempt to carry out a part, if not all, of the program which is followed

by almost all Commissions for the Blind. Of course it will be understood that all State Commissions for the Blind are maintained at the expense of the state, whereas associations derive their income from philanthropic sources. Some of these associations have sufficiently large annual budgets to undertake almost all of the work of a Commission, but usually an association's activities are confined to a large city rather than to a state. Furthermore, few of the associations have done very much as yet relative to the prevention of blindness, except by arousing public interest in the necessity for such work and by securing legislation for more effective measures. It should be noted that most of the Commissions for the Blind have come into existence as a direct result of the activities of the associations for the blind.

LIBRARIES FOR THE BLIND.

Every school for the blind has a large collection of books in some form of tactile print, and in many of these institutions libraries are available to readers throughout their respective localities. In most states a city or state library maintains a department for the blind, which is usually available to residents of the state. Details will be found under the respective states.

PENSIONS FOR THE BLIND.

It is a remarkable fact that although monetary relief was accepted as a practical form of assisting the blind in England 200 years ago, no very serious effort was made in America to aid the blind in this manner until this century. Pensions in England are provided from funds raised through charitable sources, while in America there is very little assistance of this kind which is not appropriated from city or state funds. In 1875 the city of New York began giving a pension of \$50 a year to its blind citizens, but, so far as known, no other municipality has undertaken a similar method of assisting its blind. In 1898 friends of the blind secured a modification of the Poor Laws of Ohio and a special section was inserted providing relief for the blind not to exceed \$100 per annum. In 1904 a state "Pension Law for the Blind" was passed in Ohio, but was declared unconstitutional on the ground of "class legislation." In 1908 a bill was passed "For the Relief of the Needy Blind" with a maximum allowance of \$150 per year, payable quarterly. Illinois passed a similar law in 1903, but it was optional with the counties whether they would make any payments or not, and, until 1916, when the law became mandatory, little attention was paid to it. At the present time, the states of Illinois, Iowa, Ohio, Maine, New Hampshire and Wisconsin, and the city of New York are providing outdoor relief for the blind.

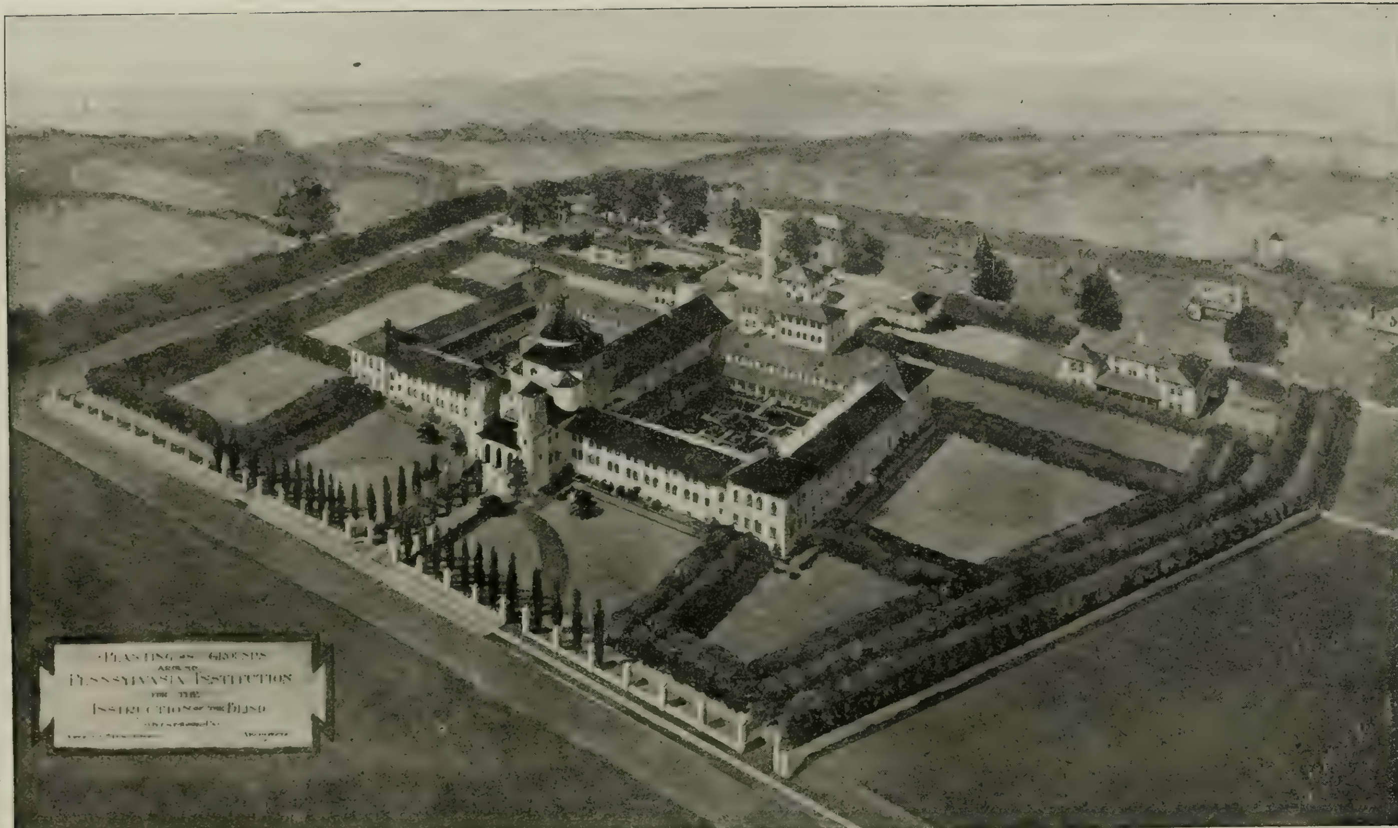


Photo from the School for the Blind, Philadelphia, Pa.

Bird's Eye View of the Pennsylvania Institution for the Instruction of the Blind.

In 1899 the school was moved to Overbrook, within the limits of Philadelphia. The plant is valued at $680,000. The playgrounds and buildings shown above cover eleven acres. The adjoining thirteen-acre field opposite the entrance, which is used for sports, gardens, orchard and grove, does not appear. The Philadelphia Institution was the first of the three oldest private schools (New York, Boston and Philadelphia) to move from the heart of a city to the suburbs.

Photo from the School of the Blind, Pittsburgh, Pa.

Sewing, Both by Hand and Machine.

Knitting and crocheting are easily learned in spite of blindness, and all women who have lost their sight should be encouraged to use their hands in this way.

The writer and compiler of the following reports wishes to thank those workers for the blind—hailing from every state and province—who have furnished and revised the material herein presented. Their cooperation has enabled him to furnish the most accurate data possible.

UNITED STATES.

ALABAMA.

School for the Blind, Talladega. School for whites, founded 1888. Capacity, 100 pupils. Valuation of plant, $100,000. Annual state appropriation, $230.00 per capita, based on attendance January 1st. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, F. H. Manning.

Industrial School for White Blind Men, Talladega. As a result of the efforts of J. S. Laverty, a blind member of the Alabama Legislature, a bill was passed in 1915 creating an industrial school for white blind men. No appropriation will be made until February 1, 1917, when $10,000 becomes available for buildings, and $100 per capita is to be allowed for maintenance. This school is to be under the management of a board of seven trustees, of which Mr. Laverty is the president.

Libraries for the Blind, Montgomery, Department of Archives and History, 88 volumes, 66 titles.

Talladega, School for the Blind, 1,101 titles.

ARIZONA.

State aid for blind infants. A law was passed in 1912 empowering the State Board of Education to provide suitable care, maintenance and instruction for blind babies and children under school age in any institute in Arizona, or any other state, at the rate of $1.00 a day. This care and training shall continue until the child attains the age of six years, and at the discretion of the board of education it may continue until the child reaches the age of twelve years.

Education of blind youth. At present, Arizona has no state school for the blind, but it sends blind children of school age to schools for the blind in neighboring states.

ARKANSAS.

School for the Blind, Little Rock. Founded, 1859. Capacity, 120 pupils. Valuation of plant, $350,000. Annual state appropriation, $45,000. For requirements for admission, course, term, and purpose

of instruction, see the Introduction to this section. The school owns about 12 acres of land, four of which are available for athletics. There is a gymnasium. Superintendent, John H. Hinemon.

Library for the Blind, Little Rock, School for the Blind, 1,770 volumes, 407 titles.

CALIFORNIA.

Institution for the Deaf and the Blind, Berkeley. Founded, 1860. Capacity, 100 (blind) pupils. Valuation of plant, $1,319,443.88; annual state appropriation, $107,500 (both departments). For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. The school occupies a tract of 130 acres. Playground space covers 3 acres. Magnificent new gymnasium and swimming pool completed in 1915. Principal, L. E. Milligan.

Industrial Home of Mechanical Trades for the Adult Blind, Oakland. Founded, 1885. Capacity, 140. Valuation of plant, $200,000. Annual state appropriation, $31,500. Needy, blind adult residents of California are eligible for admission when vacancies occur. There is usually a waiting list. The principal trade for the men is broommaking. A few devote their time to hammock-, broom-, bag- and mattress-making, and chair-caning, and the women confine themselves to fancy work. When the men reach the time of life when they are unable to work in the shops, they are allowed to spend their declining years in the institution. This was the second institution to be established in America, not connected with a school for the blind, for the industrial employment of the adult blind, and largely as the result of the efforts of a blind man, Joseph Sanders. Superintendent, Joseph Sanders.

San Francisco Association for the Blind, 1526 California Street. Work for the adult blind in San Francisco started as a reading room and library for the blind in 1902 by Mrs. Andrew Rowan, the free public library giving the use of a basement room in one of its branches. Patrons of the reading room are read to, and monthly entertainments are planned for recreation purposes. In 1906 fire destroyed all of the books and property of the association, and since that time reconstruction and expansion have gone on effectively, industrial training and employment having been added to its activities. The organization aims to assist any adult blind citizen of San Francisco who may need it. Its present home was purchased in 1913. The organization is supported entirely by voluntary contributions. Principal industries are basket- and broom-making. The activities of the organization are

carried on practically throughout the year. Fifteen men are employed regularly, and 100 helped. President, Mrs. Myer Friedman.

State paid readers for blind students. The Legislature in 1915 passed a law whereby blind graduates of the State School for the Blind in Berkeley, attending the University of California, or any of the state normal schools, shall be provided with funds necessary to employ seeing persons to read to them from text-books required for the course taken by the student; provided, however, that not more than $300, per annum, per individual, be expended. This fund is under the control of the Board of Directors of the State School for the Blind.

State paid home teaching. In 1913 provision was made that the state library employ a home teacher for the blind. At the present time one blind home teacher is employed, and confines most of her efforts to Southern California.

California Society for the Prevention of Blindness. The purpose of the organization is embodied in the title of the society. President, C. S. G. Nagel, M. D., Head Bldg., San Francisco, Cal.

Libraries for the blind. Berkeley. School for the Blind, 1,500 volumes, 400 titles. The school does not circulate its books.

Sacramento. State Library, 2,602 volumes, 1,752 titles. Books circulated not only throughout California, but to neighboring states not having libraries for the blind. A printed catalog may be had upon application.

San Francisco. Association for the Blind, 400 volumes.

COLORADO.

School for the Deaf and the Blind, Colorado Springs. Department for the blind founded in 1883. Capacity, 50 blind pupils. Valuation of plants (both departments), $390,000. Annual state appropriation (both departments), $89,000. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Poultry raising is given special attention. The school proper occupies 24 acres of land, while there are also available 200 acres on a ranch three-quarters of a mile away. Ten acres are used for athletics. There is a gymnasium. Superintendent, W. K. Argo.

Industrial Workshop for the Blind, 618 E. Arizona Avenue, Denver. Founded in 1912; capacity, 20 workers; valuation of plant, $2,000: annual state appropriation, $6,000. This shop is available for blind persons who have been citizens of Colorado for at least three years, and are over 21 years of age. The workshop and salesroom are open throughout the year.

State home teaching. The Legislature (in 1913) made it possible

Photo from the Perkins Institution, Watertown, Mass.

Perkins Institution and Massachusetts School for the Blind. Founded in 1829, Opened in 1832.

Until 1912 this historic institution was located in South Boston; now it occupies a beautiful site upon the banks of the Charles River in Watertown. Director Edward E. Allen says that he built this the newest educational plant for the blind in America upon the ''congregate-segregate'' plan. The central group of buildings, surmounted by the tower, is devoted exclusively to educational and administrative purposes. The ''cottages'' in which the girls live are to be seen at the left of the picture. The boys' cottages do not appear, but bear the same relation at the opposite end of the main building. The kindergarten buildings are at some distance in the background.

for the State Superintendent of Public Instruction to employ a blind person to give instruction to the adult blind in their own homes. While this instruction is under the direction of the State Superintendent of Public Instruction, close cooperation with the Industrial Workshop and State School for the Blind is also maintained.

Library for the Blind. Colorado Springs. School for the Blind, 1,100 volumes, 584 titles.

CONNECTICUT.

State Board of Education for the Blind. Connecticut has the unique distinction of being the only state in this country which attempts to care for the blind of all ages under one board of management. As the evolution of this effort is so different from that in other states, we are giving a somewhat fuller sketch of it. There are, however, three distinct and separate activities at work in this commonwealth—a nursery, school, and trade training department situated in different localities.

The incident which led to organized work for the blind in Connecticut occurred in 1888, when Mrs. Emily Wells Foster, in groping her way through a dark passage in a Hartford tenement-house, stumbled over a feeble, little blind Italian boy. On learning that the child was receiving no care or training, Mrs. Foster took him to her own home, where he remained for nearly a year, and was then sent to the Kindergarten for the Blind in Boston.

Mrs. Foster made some investigations into the condition of the blind in Connecticut, with the result that a large number of children were found who were being badly neglected. Up to that time the state had provided for only twenty blind children who had been sent to schools for the blind in neighboring states, while for blind adults there existed no provision whatever. Mrs. Foster saw that legislation was required, and she secured the cooperation of Frank E. Cleaveland, a blind lawyer, with the result that the General Assembly of 1893 passed an act creating a State Board of Education for the Blind, consisting of the governor and chief justice, *ex officio,* with two other members to be appointed by the governor. The Board was to take such measures as it found necessary to secure the object of its existence. Three hundred dollars a year were allowed for the instruction and training of all such blind persons as the Board allowed to become state pupils, and a secretary was to be employed who should seek out all blind persons needing care or instruction.

Before this legislation could be carried into effect, however, a nursery was opened in November, 1893, in a small house in Hartford, where

Photo from the Perkins Institution, Watertown, Mass.

Girls' Close at the Perkins Institution.

Five cottages, each a complete unit, having its own kitchen, dining room, etc., enclose a lovely court. There are two cottages on each side and the one across the end of the close is designed expressly for the teaching of domestic science.

half a dozen needy blind children were cared for until October, 1894, when a real kindergarten, numbering twenty pupils, was opened in a large house on Asylum Avenue in Hartford.

In the meantime, Mr. Cleaveland had devoted himself to the care and industrial training of a number of blind men, for which purpose he gave the use of his own house until 1895, when the state provided a building on Wethersfield Avenue for the ''Connecticut Institute and Industrial Home for the Blind.'' It also provided a new building in the rear of the kindergarten, one story of which was devoted to the temporary use of blind women until 1896, when their permanent quarters on Wethersfield Avenue were completed.

The year 1897 was a memorable one in the history of the blind, for in that year a little blind baby was brought to the Connecticut Kindergarten for the Blind where it was cordially received. We believe that blind baby to have been the first one to whom any institution in this country, except the almshouse, had opened its doors. Applications for other babies soon followed, and philanthropists enabled the managers to receive and care for a number of them, until, in 1905, the Hartford buildings being crowded, the babies, with their caretakers, were moved to a small house in Farmington. There they remained until 1910, when a large fine home in Farmington was provided for them by E. T. Stotesburg, a bountiful friend in Philadelphia. This work for blind babies can only be appreciated by those who have witnessed the deplorable consequences of neglecting them.

The Kindergarten on Asylum Avenue grew steadily and classes for older children were added. Besides the ordinary school branches, the children made rapid progress in vocal and instrumental music, and were able to enter advanced classes when sent to the Perkins Institution in Boston. Sloyd, carpentry, sewing, knitting, crocheting, and chair-caning were also taught. Piano-tuning is now added to this list.

Larger quarters were soon urgently needed and many friends contributed to the building fund, to which the state in 1909 added $50,000, and in May, 1911, the school was moved to its present fine quarters, near Blue Hills Avenue. Eighteen acres of land surround the buildings, seven acres of which are under cultivation for garden vegetables. A great part of the garden work is done by the boys, who enjoy it and find such out-of-door work a source of income on leaving school. There are now 46 pupils in the school.

The excellent Trades department, under the direction of Mr. and Mrs. R. E. Colby, has been much less fortunate than in the nursery and the school, inasmuch as it has for a long time been urgently in need of better quarters. A forty acre lot just south of the city has for

three years been waiting for the needed buildings. These the trustees are now hoping to see erected within a year, as the state has just given $60,000 to the institution for that purpose.

The industries taught and carried on in this department are the making of brooms, mattresses, rugs, and baskets, chair-seating, sewing, crocheting, knitting, typewriting, and stenography. Farm work proves as practical for the men as for the boys. There are today 42 blind, or partially blind, persons in the Trades department.

It will be seen, from what has been said, that the Connecticut Institute for the Blind is peculiarly comprehensive in its work, inasmuch as it aids the blind of all ages to make the most of their lives.

Superintendent, Nursery for Blind Babies, Miss Lillian Russell.

Superintendent, School Department, G. H. Marshall.

Superintendent, Trades Department, R. E. Colby.

Library for the Blind. Hartford, School Department Institute for the Blind.

DELAWARE.

Commission for the Blind, 305-7 West 8th St., *Wilmington.* In 1909 the Delaware Legislature created a Commission for the blind, the chief function of which is to assist the adult blind. The work of the Commission is divided into home instruction, carried on by means of home teachers, and industrial training and employment given in a workshop for the blind where rugs, brooms, and baskets are made, chairs are re-seated, and orders for piano-tuning are solicited. About 25 individuals receive direct assistance from the shop. The articles made by the blind both at home and in this shop are sold at the store located in the Commission's headquarters. The blind children capable of benefiting by training are sent to schools for the blind in the neighboring states. Secretary, C. B. Van Trump.

Library for the Blind. Wilmington Institute. Free Library, 772 volumes, 415 titles. An ink print catalog is provided without charge for residents of the state to whom books are circulated.

DISTRICT OF COLUMBIA.

Aid Association for the Blind, 3050 R Street, N. W., *Washington, D. C.* Organized in 1897. This institution has a capacity of thirty men and women; the valuation of its plant is $50,000, and it is supported entirely by voluntary contributions and income from endowment. Contrary to what might be gathered from the title of this organization, the institution is a "Home" and today occupies a fine, specially constructed building with separate quarters for white and colored

of each sex. The basement, which is almost entirely above ground, well lighted and ventilated, serves as a work-room for men who wish to be industrially occupied. The women confine themselves to fancy work. Applicants are not required to pay an admission fee but must have been residents of the District of Columbia.

District of Columbia Association of Workers for the Blind. Organized 1914. Active members are blind and must be residents of the District one year. There is no restriction as to residence for associate members but they cannot vote. Funds derived from membership pay current expenses, while the money received from entertainments goes to the benefit fund. President, French F. Hufty, 1808 H St. N. W., *Washington.*

The Columbia Polytechnic Institute for the Blind, 1808 H St. N. W., *Washington,* was founded in 1900. Its capacity is 15; valuation of plant, $18,000. It is supported entirely by voluntary contributions and proceeds of work. This institution is virtually a job press printing plant in which all the work that can be done by the blind is given to them. The profits from the labor of the seeing helpers goes towards the maintenance of the plant. A quarterly magazine in ink print entitled "*Voices from Darkland*" is issued which is "edited, managed, folded, inserted, stitched, trimmed, wrapped and addressed for the mail by the sightless." Any sightless man or woman (white) who has need of employment and who is a resident of the District of Columbia may apply and if possible assistance will be given. An effort is made to find employment for tuning and piano instruction. The workers do not reside in the institution. At present ten are employed. Manager, R. W. Swann.

The Library of Congress, Department for the Blind. For details about this Library, see end of this section.

National Library for the Blind, 1729 H. St. N. W., *Washington.* For details about this organization, see end of this section.

FLORIDA.

School for the Deaf and the Blind, St. Augustine. Founded in 1885. Capacity, 40 (blind). Valuation of plant, $225,000 (both departments). Annual state appropriation, $35,000 (both departments). For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. The schools own 25 acres of land, 8 of which are used for athletics. President, A. H. Walker.

Library for the Blind. St. Augustine, School for the Blind, 175 titles.

Photo from the School for the Blind, Baltimore, Md

Domestic Science is Being Given in All Schools for the Blind.

In those having the ''cottage system'' the blind girls are able to take a large share in the actual work of the household.

GEORGIA.

Academy for the Blind, Macon. Founded, 1851. Capacity, 125 pupils. Valuation of plant, $150,000. Annual state appropriation, $30,000. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. The school owns 20 acres of land, 6 of which are available for athletics. There is a gymnasium. This school has a fund of $10,000 known as the "pupils' fund" the interest from which is used for assisting students after they leave the school. Superintendent, George F. Oliphant.

Library for the Blind. Macon, Academy for the Blind, 2500 volumes, 409 titles. Books are not loaned outside of the school.

IDAHO.

School for the Deaf and the Blind, Gooding. Founded, 1906. Capacity, 25 (blind). Valuation of plant, $70,000 (both departments). Annual state appropriation, $30,000 (both departments). Originally located in Boise, destroyed by fire in 1908, moved to new buildings in Gooding in September, 1910. For requirements for admission, course, term, and purpose of instruction, see the Instruction to this section. Superintendent, W. E. Taylor.

Library for the Blind. Gooding, School for the Blind, 200 volumes, 150 titles, 750 volumes in ink print.

ILLINOIS.

Illinois School for the Blind, Jacksonville. Founded, 1849. Capacity, 225. Valuation of plant, $312,000. Annual state appropriation, $91,300. School owns 37 acres of land, 5 of which are available for athletics. There is a gymnasium. This school operates a printing plant which specializes in the production of Braille music. Catalogs may be had upon application. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, H. C. Montgomery.

Co-education of the Blind and the Seeing, Chicago Public Schools. Classes for blind children were established in the public schools of Chicago in September, 1900. There are three centers for children in the elementary grades, as well as three high schools attended by other blind students. Historically, the Chicago work is of great interest, as it was in this city that the first attempt in America was made to educate blind children by the side of those who see. The general policy followed in this method of education is described in the Introduction to this section. It should be added that Chicago and

Northwestern Universities both give scholarships to every student capable of entering these universities and who has been recommended to them from the public schools. It is also gratifying to state that all those who have availed themselves of this education have done satisfactory work. Three of those who have graduated are now paid teachers, one at the State School for the Blind, Jacksonville, and two in the Department of Instruction for the Adult Blind. Supervisor, John B. Curtis.

Visitation and Instruction of the Adult Blind, 5618 Drexel Ave., *Chicago.* Established in 1911 and operated under the State Board of Administration. For five years previous to this the work was conducted along similar lines by the Chicago Women's Club. Five teachers are employed. About 200 blind people were visited in 1915, to 85 of whom instruction was given in reading, writing, typewriting, operating a dictaphone machine, embossed shorthand, sewing, knitting, crocheting, basketry, hammock-making, chair-caning, broom-making, and piano-tuning. As far as possible, an effort is made to sell the work of the pupils through bazaars and exhibits. Superintendent, Chas. E. Comstock.

Industrial Home for the Blind, Marshall Boulevard, *Chicago.* Founded 1894. Capacity, 100. Valuation of plant, $100,000. Annual state appropriation, $35,000. 68 men; 26 women. Applicants must be residents of Illinois. The principal trade is broom-making. The women do some fancy-work, and those who can help with the housework. Forty-one men live outside of the institution, and come to work daily. Superintendent, William F. Schultz.

Pensions for the Blind. In 1903 a law was passed permitting counties to provide financial relief for blind men over 21 years of age and women over 18 years having an income of less than $250 a year, who are not inmates of charitable institutions, and who have resided in the state continuously for 10 consecutive years, and in their respective counties for 3 years. The amount of annual benefit is $150, payable quarterly. Although this law was passed in 1903, it was not mandatory upon the counties; therefore it was not generally observed. In June, 1915, however, the law was amended so that furnishing this form of relief is now obligatory.

Illinois Association for the Prevention of Blindness, 30 North Michigan Boulevard, *Chicago.* Organized 1914. Employed an executive secretary 1916. Executive Secretary, Miss Carolyn C. Van Blarcom.

Libraries for the Blind. Chicago, Public Library. 1449 volumes. The books are circulated throughout the state. Both printed and embossed catalogs are available without charge.

Jacksonville, School for the Blind. 4500 volumes; 1800 titles in the circulating library. 3000 volumes, 500 titles in pupils' library. Books in circulating library are sent throughout the state.

INDIANA.

Indiana School for the Blind, Indianapolis. Founded 1847. Capacity, 160. Valuation of plant, $772,567.65. Annual state appropriation, $45,500. The school owns eight acres, of which three are available for athletics. There is a gymnasium and swiming pool. For requirements for admission, course, term and purpose of instruction, see the Introduction to this section. Superintendent, George S. Wilson.

Board of Industrial Aid for the Blind, Indianapolis. Founded 1915. This organization, although operating under a different name, is, for all intents and purposes, similar to other State Commissions for the Blind. The purpose and general scheme of work is like that mentioned under commissions in the Introduction to this section. Although the law creating this board makes it entirely independent of the School for the Blind, so far as its duties and powers are concerned, the law directs that the same group of men who form the Board of Trustees of the State School for the Blind shall manage the affairs of the Board of Industrial Aid for the Blind. On Sept. 25, 1915, the Board of Industrial Aid acquired by a lease the plant, formerly known as the Industrial Home for Blind Men, and it is now known as Shop No. 1. Founded 1898. Valuation of plant $5,000. Average of 20 men employed in the shop. Open to residents of Indiana. Executive Secretary, C. D. Chadwick.

Indiana Association of Workers for the Blind, Indianapolis. Organized Dec. 12, 1912. The purpose of this organization is to promote the interests of the adult blind of Indiana, and to aid in the prevention of blindness. Interest in the welfare of the blind and the payment of annual dues admits to membership. Sessions are held biennially in the summer, and the organization is maintained by membership dues and private subscriptions. President, B. F. Smith, 135 West Fall Creek Blvd., Indianapolis.

Libraries. Indianapolis, School for the Blind. 2,074 volumes; 690 titles.

Indianapolis, State Library, 639 volumes; 366 titles. New York Point catalog available without charge. Books circulated throughout the state.

IOWA.

College for the Blind, Vinton. Founded, 1853. Capacity, 140. Valuation of plant, $250,000. Annual state appropriation, $41,600.


Photo from the Maryland School for the Blind.

Buildings of Maryland School for the Blind.

The school owns 40 acres of land, 10 of which are available for athletics. There is a gymnasium and swimming pool. For requirements for admission, course, term and purpose of instruction, see Introduction to this article. Superintendent, G. D. Eaton.

Pensions for the Blind. In 1915 a law was passed permitting counties to contribute $150 per annum "from the poor fund" toward the support of male blind persons over 21 and female blind persons over 18 years of age whose income is less than $300 a year, who have resided in the state continuously for five years and the county for one year.

The Iowa Home for Sightless Women, 1424-30th St., *Des Moines, Iowa.* Movement to establish the home began in 1907; it was opened September, 1915. Capacity, 8. Valuation of plant, $9,000. Supported by private contributions and donations from different clubs in the state. Applicants are required to pass a medical examination, to be free of contagious diseases or symptoms of insanity, and to pay an admission fee of $300. Inmates of the Home assist with the housework and do different kinds of fancy work. Sales are conducted to dispose of the work of the women. Secretary, Board of Managers, Miss Eva A. Whitcomb, 1424-30th St., Des Moines, Iowa.

Iowa Association for the Blind, Des Moines. Organized, 1901. The society has done work in the interest of the blind of the state. President, Mrs. J. B. Jordan, Vinton, Iowa.

Libraries for the Blind. Des Moines, Iowa Library Commission. 267 volumes; 165 titles. The books are circulated throughout the state. Printed catalog free upon application.

Vinton, College for the Blind. 3786 volumes; 500 titles. Books are circulated throughout the state.

KANSAS.

School for the Blind, Kansas City. Founded, 1867. Capacity, 100. Valuation of plant, $160,000. Annual state appropriation, $36,000. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. The school owns six acres of land, two of which are available for athletics. There is a gymnasium. Superintendent, Mrs. G. N. Roseberry.

Library for the Blind. Kansas City, School for the Blind. 329 volumes; 248 titles. Books may be circulated throughout the state.

KENTUCKY.

Institution for the Education of the Blind. Founded, 1842. Capacity, 150. Valuation of plant, $200,000. Annual state appropriation,

$40,000. The school owns 25 acres of land, 10 of which are available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, Susan B. Merwin.

Kentucky Workshop for the Blind, Louisville. Founded, 1913. Capacity, 8. Uses rented quarters and has, as yet, no appropriation from the state. Principal industries, broom- and mop-making. Applicants must be over 18 years of age. Superintendent, Clifford B. Martin.

Kentucky Society for the Prevention of Blindness, Lexington. Founded, 1910. Maintained by private subscriptions. The purpose of this organization is to do anything that will assist in the prevention of blindness. Trachoma has made fearful ravages throughout the state. In spite of the fact that the National Government has seen fit to establish hospitals in the mountain sections (See p. 1156, Vol. II of this *Encyclopedia*), state funds have not, as yet, been appropriated to help in this work, and the above society is doing everything possible to stimulate greater interest in the need for state aid for the campaign to prevent unnecessary blindness. In the meantime its executive secretary uses the money of the mountain fund to help those who need medical attention for their eyes. Executive secretary, Miss Linda Neville, 722 W. Main St., Lexington, Ky.

The Mountain Fund. This is a private organization supported by voluntary contributions. Its purpose is to enable eye sufferers who are needy and live remote from oculists to have expert treatment in the medical centers of Kentucky. Miss Linda Neville began trying to secure adequate medical attention for eye diseases with the support of the so-called Mountain Fund before the Society for the Prevention of Blindness was established. Miss Neville is the guiding spirit in both organizations. Manager, Miss Linda Neville, Lexington.

American Printing House for the Blind, Louisville. This is a National printing house for institutions for the blind throughout the United States. For full particulars, see the end of this section.

Libraries. Louisville, Free Public Library, 293 volumes; 268 titles. The books are circulated throughout Kentucky.

Louisville, Institution for the Blind, 400 titles; 2423 volumes. Books are circulated only among pupils of the school.

See, also, **Alphabets and Literature for the Blind,** p. 257, Vol. I of this *Encyclopedia.*

LOUISIANA.

School for the Blind, Baton Rouge. Founded, 1856. Capacity, 60. Valuation of plant, $100,000. Annual state appropriation, $15,000.

The school owns 10 acres of land, 3 acres of which are used for athletics. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, G. C. Huckaby.

Louisiana State Commission for the Blind. Organized 1916. Voluntary association interested in the prevention of blindness and industrial occupation for the blind. Secretary, Rev. A. Oscar Browne, M. D.

St. Beatrice Circle of St. Margaret's Daughters, New Orleans. A voluntary organization which gives assistance to the blind of New Orleans. The activities of this organization are to some extent similar to those of the Associated Charities. Where necessary, assistance is furnished in the form of groceries, clothing and money for board. Social entertainments are given several times a year, to which all the blind of the city are invited. Home teaching is carried on among the blind, but all the work is done by volunteers, and no salaries are paid. President of the organization, Mrs. Finley D. Ross, 917 Washington Ave., New Orleans, La.

Library for the Blind. Baton Rouge, School for the Blind, 794 volumes; 460 titles. The books are circulated throughout the state. A printed catalog will be furnished upon application.

MAINE.

Maine Institution for the Blind, 201 Park Ave., *Portland.* Founded, 1906. Capacity, 46 men and 14 women. Valuation of plant, $75,000. Annual state appropriation, $15,000. Applicants must be between the ages of 18 and 50, and too blind to earn their living by ordinary means. The men board in the vicinity; the women all live at the Institution. The trades followed are broom-making, chair-making, basketry, mattress-making, upholstery, sewing, weaving rugs. Superintendent, M. W. Baldwin.

State Aid for Blind Infants and Youths. Maine makes provision of $1.00 a day for the care, medical treatment, maintenance and education of blind infants and children under school age whose parents are unable to care for them properly. These infants may be sent to a nursery for blind babies outside of the state. When blind children are old enough to go to a school for the blind, the state will pay for their tuition while attending such institution in a neighboring state.

Pensions for the Blind. In 1915 the legislature of Maine passed a law empowering the governor and council to authorize the state treasurer to pay $200 a year, quarterly, to all blind persons over the age of 21 who are not charges upon any charitable or penal institution. They must have less than $300 a year, must have resided in the state

continuously for 10 consecutive years, and in their respective counties for at least one year immediately prior to applying for the benefit.

MARYLAND.

School for the Blind, Overlea. Founded in 1853. Capacity, 130. Valuation of plant, $500,000. Annual state appropriation, $45,000. There is, also, an income receivable from an endowment fund. The school owns 100 acres of land, 10 of which are available for athletics. There is a gymnasium.

For requirements for admission, course, term, and purpose of instruction see the Introduction to this section.

Until 1911 the Maryland School for the Blind had been located in the city of Baltimore; now a magnificent new plant has been erected in one of the suburbs of the city, known as Overlea. Upon the same extensive tract of land is located the school for the colored deaf and blind. The new institution for white children is built upon the cottage plan. The school and administration building is in the center of the group of buildings. To the east are two cottages for girls with a capacity of 30 each, and at the west are two cottages of the same capacity for boys. In addition to conducting in this school the general work outlined in this section under the caption "Residential Schools for the Blind," it should be mentioned that one of the practical results of the cottage plan makes it possible for blind young women actually to take part in preparing some of the meals under the supervision of the domestic science teacher. With such a recently built plant, the equipment and all the appointments are up-to-date, and Maryland may justly consider herself as having one of the model institutions in this country. Superintendent, John F. Bledsoe.

Workshop for the Blind, Baltimore. As mentioned in the general introduction to this section, the earlier schools for the blind soon recognized the need of some shop in which to carry on the trades the pupils had already learned and, in 1871, Maryland may be said to have definitely made a start to do something for the adult blind, under the auspices, however, of the School for the Education of Blind Youth. A workshop in which broom-making is the chief industry, although mattresses and baskets are also made, was opened in Baltimore, and later this shop was moved to a building upon the school grounds.

In 1906 the legislature appointed a Commission to investigate the condition of the adult blind and gave $1,500 for its work, and the outcome of this investigation was a legislative enactment, in 1908, creating a Workshop for the Blind, the management of which was to

be under a board of directors, two to be appointed by the Maryland School for the Blind, and three by the Governor. The nucleus of this organization was the well organized shop of the school which was started in 1874. From the appointment of the Commission to the final appropriation of state funds for the partial support of a workshop for the blind, great interest was aroused throughout Baltimore and vicinity in behalf of this institution. The blind themselves were

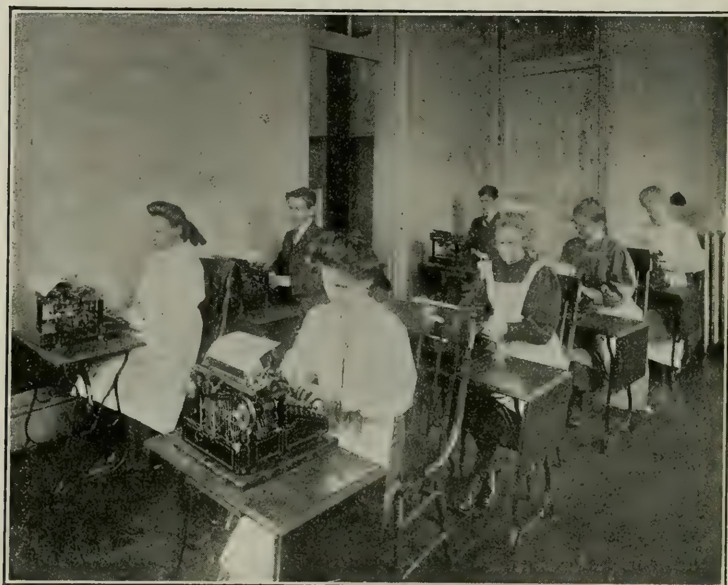


Photo from the School for the Blind, Baltimore, Md.

Every Blind Child Should be Encouraged to Learn to Use a Typewriter.

A few can earn their living by writing shorthand upon a specially arranged machine or by transcribing from a phonograph. Almost all blind people have at some time to communicate with the seeing, hence the value of learning to use a typewriter.

most active in helping to raise funds, and today there is a fine four story factory building as a monument to this campaign.

One hundred and seventy-seven blind men and women are employed in the shop. The plant is valued at $70,000. The state and city have contributed jointly $20,000 annually during the past two years toward the maintenance of the institution. Private subscriptions have also been received. The principal trades are broom- and basket-making, re-seating of chairs, and piano-tuning. Mattresses, rugs, hammocks

and mops are also made. The school and workshop train switchboard operators. Superintendent, George W. Conner.

Home Teaching. During the vigorous campaign to establish firmly the above mentioned workship, effective home teaching has been carried on. Today the headquarters of this work are in the workshop, where a sales-room is maintained for the disposal of the products of home workers. Instruction is given in sewing, knitting, crocheting,

Photo from the School for the Blind, Pittsburgh, Pa.

All Blind People Must Learn to Use Their Hands as Effectively as Possible.

One of the most practical methods of helping boys to use their hands is by giving them a thorough course in manual training.

weaving and basket-making. The school supports two home teachers, the workshop one home teacher and the Maryland Association of Workers for the Blind one county home teacher. Supervisor, Miss Virginia Kelly.

Maryland Association of Workers for the Blind, Associated Blind Men of Maryland, Associated Blind Women of Maryland, 501 W. Fayette St., *Baltimore.* These three voluntary organizations are made up of the most intelligent blind men and women of the state, with their friends. Each has taken a very active part in helping to raise funds

to carry forward the work for the adult blind. The cooperation and unanimity of workers for the blind in Baltimore has been very striking.

Maryland Association for the Prevention of Blindness. Established 1909. Principally active in furthering legislation. Secretary, Dr. James J. Carroll.

Libraries for the Blind. Baltimore, Enoch Pratt Free Library; 685 titles; 1757 volumes. Books may be circulated throughout Maryland.

Overlea School for the Blind; 700 titles; 3,675 volumes. The books may be circulated throughout the state. Catalogs in New York point are supplied free of charge.

MASSACHUSETTS.

Perkins Institution and Massachusetts School for the Blind, Watertown. Founded, 1829; opened, 1832; resident capacity, 300 and a full staff of officers, teachers and servants; valuation of plant, $1,000,000; annual state contribution, $30,000. The Institution receives its chief income from endowments, subscriptions, and fees. The legislatures of Maine, Rhode Island, Connecticut and New Hampshire pay $300 per annum for each child sent to the Perkins Institution by these states.

The Perkins Institution, like many others of the older schools, was established in a city and after some years became cramped for playgrounds. The institution (except for the kindergarten and the cottages for the girls' department) also used a building which was originally planned for a hotel. When the school left South Boston for Watertown in 1912, it moved into the most complete and modern group of buildings arranged for the education of the blind in the United States. Director Edward E. Allen, who was the principal of the School for the Blind in Philadelphia when it moved from the city to the suburbs, also supervised the re-building of the Perkins Institution.

It is interesting to note that there have been but two directors of this school previous to the incumbency of Mr. Allen. Its first head was Dr. Samuel Gridley Howe, who may be termed the father of the education of the blind in the United States. (See p. 255, Vol. I, of this *Encyclopedia.*) Those who have studied the early reports of this great seer touching possibilities for the blind are amazed to find that his observations regarding the education, training and care of the blind, whether infant, youth or adult, although written more than half a century ago, conform to and, in many cases, foreshadow the best methods of the present time. Dr. Howe was indeed a great originator in all departments of this work. He was succeeded in 1876 by his son-in-law, Michael Anagnos (See p. 336, Vol. I, of this *Encyclopedia*),

who will be remembered as the great advocate of kindergartens for the blind. It was as a result of his efforts that a large endowment fund was raised to found and carry on the kindergarten department of Perkins Institution, which, for 25 years, was conducted in a special plant of its own at Jamaica Plain, a suburb of Boston. Mr. Anagnos also advanced the educational methods of the older school in every way, keeping well abreast of the times, and, by securing a splendid endowment fund for the main institution, made possible its continued growth and prosperity. He died in 1906. Mr. Allen became director in 1907

Boston Nursery for Blind Babies.

and is carrying out with better facilities the fundamental policies of his predecessors.

The present extensive plant stands on 34 acres of land on the banks of the Charles River, in Watertown. The central tower, which dominates the otherwise low-spreading buildings, is meant to stand for the aspiration of the Institution for its pupils. The illustrations of this section show the general appearance of the buildings. Pupils and staff live together in families of about 25, each group having its individual dining-room, kitchen and complete equipment. The cottages are grouped together around closes, much as in an English public school. This arrangement of individual cottages makes it possible to continue a policy inaugurated by Dr. Howe, namely, that of having the young people take a large part in the actual household duties. Mr. Allen is a firm believer in what he terms "contributory effort,"

and the boys as well as the girls not only take care of their rooms, as is customary in many schools where no tuition is exacted, but do the major part of the other housework, with the exception of cooking and laundering. The hired domestic service is reduced to a minimum, the young people being encouraged to do everything they can to help in the running of their cottages. It seems hardly necessary to say that this plan is adopted not for the sake of economy alone but also for its beneficial effect upon the pupils themselves. We have dwelt upon this plan of contributory effort, for it may truly be said to be the school's unique feature, and, while some other institutions attempt to do the same, as far as that is possible with their congregate form of equipment, it is most earnestly hoped that, as other schools are remodeled from time to time, similar opportunity may be given to the boys and girls.

No sketch of the Perkins Institution would be complete without referring to the fact that it was Dr. Howe who first taught the possibility of educating children who are not only blind but also deaf. Beginning with Laura Bridgman, the school has always provided instruction for a few deaf-blind pupils. Helen Keller, a well-known member of this group of people who have been so well trained was educated by a graduate of Perkins Institution and spent some years there.

Another unique feature of the Institution is its special reference library of books relating to the blind, collected by Mr. Anagnos. No other institution or library in the world has such a complete collection of books in English about, for, and by the blind. While these books cannot be taken from the library, anyone may consult them there or may borrow the published catalog.

For requirements for admission, course, term, and purpose see the Introduction to this section. Director, E. E. Allen.

Howe Memorial Press, Perkins Institution. This printing establishment is operated from the income of an endowment fund of $200,000 raised by Mr. Anagnos. It makes and publishes books and music in the American Braille type (See p. 249, Vol. I of this *Encyclopedia*), and sells, at cost, special appliances. Schools for the blind and libraries may purchase its publications at 25 per cent less than cost price. Manager, Frank C. Bryan.

State Home-teaching for the Adult Blind. This activity is also under the supervision of the Perkins Institution. In 1900 the Massachusetts legislature appropriated $1,500 for the inauguration of home teaching, being the first state in the Union to set aside public funds for this purpose. The appropriation has since been increased to $5,000, the supervision of the work being delegated to the State Board of Edu-

cation, whose plans have been carried out under the direction of the Perkins Institution. Four blind instructors visit the adult blind in their homes, to give them lessons in reading and to instruct them in such other occupations as may be of service to them at home. After the Massachusetts Commission for the Blind was established, the authorities of the Perkins Institution and representatives of the Commission petitioned the legislature to place the direction of this work under the Commission. In the spring of 1916 this transfer was made. Principal teacher, John Vars.

Perkins Institution Workshop, 549 East 4th St., *South Boston*. Founded 1848; capacity 24; valuation of plant, $8,000. Receives no city or state appropriation but owns its building and hires (at a nominal figure) its salesroom at 383 Boylston St., Boston, Mass., one of the best shopping localities in the city. The principal industries are mattress-making and chair-caning. No boarding house is maintained. the men and women living in the vicinity, or wherever they please.

Historically, this shop is of interest since it was the first to be established in the United States. As mentioned in the Introduction to this section, the directors of the first schools for blind youth in this country soon realized that something ought to be done for those who, after leaving school, were unable to support themselves without supervisory assistance. It was for this reason that Dr. Howe opened his workshop near the Perkins Institution, and followed it up by opening a salesroom in the shopping district, where orders might be taken and samples of the work displayed. As the work is charitable in nature, both the shop and the salesroom (which is owned by the Kindergarten for the Blind) are exempt from taxation, and the business is therefore not obliged to pay much for its housing. This is mentioned because the shop has the remarkable record of practically making ends meet, which is not true of any industrial establishment for the blind in the United States, and would not be true of this one if it had not indirect state aid through tax exemption. It should be noted, further, that the shop employs only those who are capable of doing good work. In other words, only artisans are regularly employed (although apprentices have sometimes been received) and the overhead charges are very moderate which also helps to explain the unusual showing which this shop has made. Manager, F. C. Bryan.

The Massachusetts Association for Promoting the Interests of the Adult Blind. This organization came into existence in 1903 with the avowed purpose of securing the establishment of a State Commission for the Blind. To do this it conducted the first series of illustrated lectures on blindness and the blind systematically given in any state

Photo from the School for the Blind, Philadelphia, Pa.

Summer House in Process of Construction by Blind Boys.

Practical application of sloyd training. These boys are building a summer house for themselves.

Photo from the School for the Blind, Philadelphia, Pa

Corner of Boys' Cane Shop Showing Varieties of Caning Taught.

in the union. The then executive secretary, (the writer of this section) accepted invitations to give illustrated addresses to women's and men's clubs and church organizations in all parts of the state, and the public was aroused to the possibilities of the service which could be rendered to the blind by the establishment of a commission. At the same time that this publicity campaign was being carried on, the Association opened an "experiment station" for the trade training of the blind and made a vigorous effort to find new industrial opportunities for the blind. It is of historical interest to note that in this experiment station the first recorded effort in fabric-weaving and artistic rug-making by the blind in this country was undertaken. It was also here that a beginning was made in the manufacture of the so-called "Wundermop" a string mop invented by a blind man. It was also as a result of the efforts of the director of this experiment station that the attempt was made to place blind people in factories other than those in which tuning is carried on. The Dennison Manufacturing Company was the first to open its doors to employees of this kind. When the State Commission was created the industries which had been begun in this experiment station were taken over as the nucleus of the workshops which have since been carried on by the state board. After the Commission for the Blind was created the Association continued to exist and it still cooperates with the Commission very closely, and is of great service to it. For example, it started and maintained work for the prevention of blindness, until the Commission took this effort over; also, when Mrs. James A. Woolson gave her property in Cambridge to be used as a social and industrial center for blind women, it was made over to the Massachusetts Association, which organization has made itself responsible for the maintenance of this social settlement for the blind.

When the *Outlook for the Blind,* an ink-print publication devoted to the interests of the blind, was founded in 1907, the Massachusetts Association generously made up the annual deficit for several years until the magazine had won for itself sufficient recognition to command the financial assistance of contributors in other parts of the country. While the Massachusetts Association cannot point to any extensive equipment of its own, it is unquestionably a fact that much of the modern effort to render practical assistance to the adult blind in this country has had its inspiration from the modest, but effective work inaugurated by this Association in Massachusetts, the most direct outcome of which was the creation of the first permanent Commission for the Blind in America. Secretary; E. E. Allen, Perkins Institution.

Massachusetts Commission for the Blind, Central Office and Sales Room, 3 Park St., *Boston.* The Commission was established in 1906, and as indicated above, took over, as a basis of this industrial work, the shops which had been begun by the Massachusetts Association.

One of the first pieces of work undertaken by the Commission was to make a complete register of all the blind in the state. This had been partly accomplished by the temporary commission appointed in 1903 to investigate the needs and conditions of the blind. As there was no precedent for this commission to follow in inaugurating its work it was essential that it should have a comprehensive record of the large number of blind in the state. We mention this census of the Massachusetts Commission for it is an unfortunate fact that other subsequent commissions have blindly copied this feature of the Massachusetts Commission as if no work could be done without it, and we wish to take this opportunity to suggest that other states that may be contemplating work for the adult blind do not need to spend their efforts in trying to create a so-called census of the blind. To be accurate a census must be taken throughout a given territory in the shortest possible time, and since Massachusetts has this very complete record of its blind population, those who wish to secure facts about age, when blindness occurred, etc., can find this information by referring to the first reports of the Massachusetts Commission, and it is reasonable to presume that the same general facts will hold good in other states. A compilation of a register is quite different from the taking of a census, and every well organized charity begins a register the day it opens its doors.

One of the most interesting features of the Massachusetts Commission is the chain of workshops which it has opened in Cambridge (where there are three), Pittsfield, Lowell, Worcester and Fall River. In the four last-named cities mattress-making and chair-caning are the principal industries, and there is some broom-making carried on in Pittsfield. To each of these shops the men come from the surrounding locality, living in their own homes, or boarding in the vicinity. The Commission maintains no subsidized boarding house.

In Cambridge the largest of the three shops (at 686 Massachusetts Avenue) is given up exclusively to rug-making and mop-making, which are primarily carried on by men, although a few women are employed for knotting and finishing the rugs.

The second shop (at 134 Brookline street), is also for men, who make brooms, and re-seat chairs and (more recently) carry on a willow industry.

The third shop, located at 277 Harvard street, stands in the garden of the Woolson House Estate, and is for women only. In this building

Photo from the School for the Blind, Philadelphia, Pa.

Hammock Making and Weaving Rag Carpets and Rugs.

All schools give more or less trade training. Weaving, hammock-making, broom- and basket-making, chair caning and tuning are the principal industries.

Photo from the School for the Blind, Philadelphia, Pa.

Piano Tuning and Repairing is One of the Most Lucrative Occupations for Capable Blind Men.

the women devote themselves to art fabric-weaving, rug-making, and chair-caning. As was mentioned under the Massachusetts Association, the property at 277 Harvard street is held by the Massachusetts Association, the old Woolson home now serving as a delightful residence for homeless blind women who are employed in the industries. It is also used as a vacation house in the summer for those who need the benefit of a change, and as a visiting place for newly blind women. The Massachusetts Commission is entirely responsible for carrying on the art fabric shop, but of course it pays no rent for the use of the building. Instruction in whichever trade seems to be most suitable is given to able-bodied, blind residents of Massachusetts, provided there is room in one of the various shops at the time application is made. At its discretion, the Commission may loan tools and materials (which are to be returned or paid for on easy terms) to blind home workers. The mops, rugs and brooms are disposed of through the sales room, which is maintained by the Commission at 3 Park street and, during the summer season, at a sales room at Manchester-by-the-Sea.

The general purposes of the Commission are completely outlined in the Introduction to this section. General Superintendent, Miss Lucy Wright.

Defective Eyesight Class in Public Schools. In April, 1913, a class for children having defective eyesight was opened in one of the Boston public schools. For details of the methods pursued in such a class, see the Introduction to this section. The superintendent of schools makes this significant comment in his annual report for 1913: "The progress made by the children to whom school had meant almost nothing has been remarkable, showing that the effort is well worth while if the children can be reached."

Boston Nursery for Blind Babies, 147 South Huntington Ave., *Roxbury.* Incorporated, 1901. Capacity, 25. Valuation of plant, $36,-400. Supported by an endowment and voluntary contributions. Any blind or partially blind child under five years of age is eligible for admission. The state pays a *per capita* sum for state minor wards. When able to pay, the parents or guardians are expected to defray as much of the expense as possible, although admission may be free when circumstances warrant it. The purpose of the nursery is to provide a home and hospital care for infants; also to supply by training the education that the physically normal child acquires by imitation. The Nursery also admits a limited number of children requiring special care to prevent blindness. The home and hospital are open all the year. It is interesting to note that this is the first nursery for blind babies which erected a special building for its wards. It is a

model of its kind. Any one observing this beautiful structure facing a portion of Boston's park system, would never think of it as an "institution" but rather as a private residence of some wealthy family. Indeed, those in charge of the Nursery have done everything in their power to approximate home conditions for these little people. Superintendent; Miss Jane A. Russell.

Worcester Memorial Home for the Blind, 81 Elm St., *Worcester.* Founded, 1905. Capacity, 14. Valuation of plant, $9,500. Supported by private contributions and board of residents. It is open to blind women so far as space allows, without restriction, to residents. An admission fee or regular payments for board, according to circumstances, is charged. It is the hope of the organization to provide other cottages for the homeless blind. The women do what they can towards the upkeep of the house, and are happily and busily occupied with fancy work, which is sold by means of occasional sales. Matron, Miss Bessie Rice.

Libraries for the Blind. Boston, Public library, 548 titles, 1052 volumes. The circulation of books is not restricted to any particular territory.

Brookline, Public Library, 75 titles, 109 volumes. Books are circulated in Brookline.

Lynn, Public Library, 205 titles, 255 volumes. No territory limit to circulation; blind assistant teaches all the various types for the blind. A reading room for the blind is open three days of each week.

New Bedford, Free Public Library, 137 titles, 214 volumes. No territory limit to the circulation.

Watertown, Perkins Institution, 1878 titles, 13,999 volumes. Printed catalogs are distributed free wherever needed. Books are circulated throughout United States and Canada.

Worcester, Free Public Library, 164 titles, 292 volumes. The books are circulated through central Massachusetts.

MICHIGAN.

School for the Blind, Lansing. The Michigan School for the Blind was organized as a department of the State Institution for the Deaf and Blind and maintained at Flint, from 1854-1881. A separate school was authorized by the legislature in 1879 and opened in Lansing in 1881. Capacity, 200. Valuation of plant, $249,843.29. Annual state appropriation, $57,000. School owns 43 acres of land, one of which is available for athletics. For requirements for admission, course, term, and purpose of institution, see Introduction to this section. Superintendent, Clarence E. Holmes.

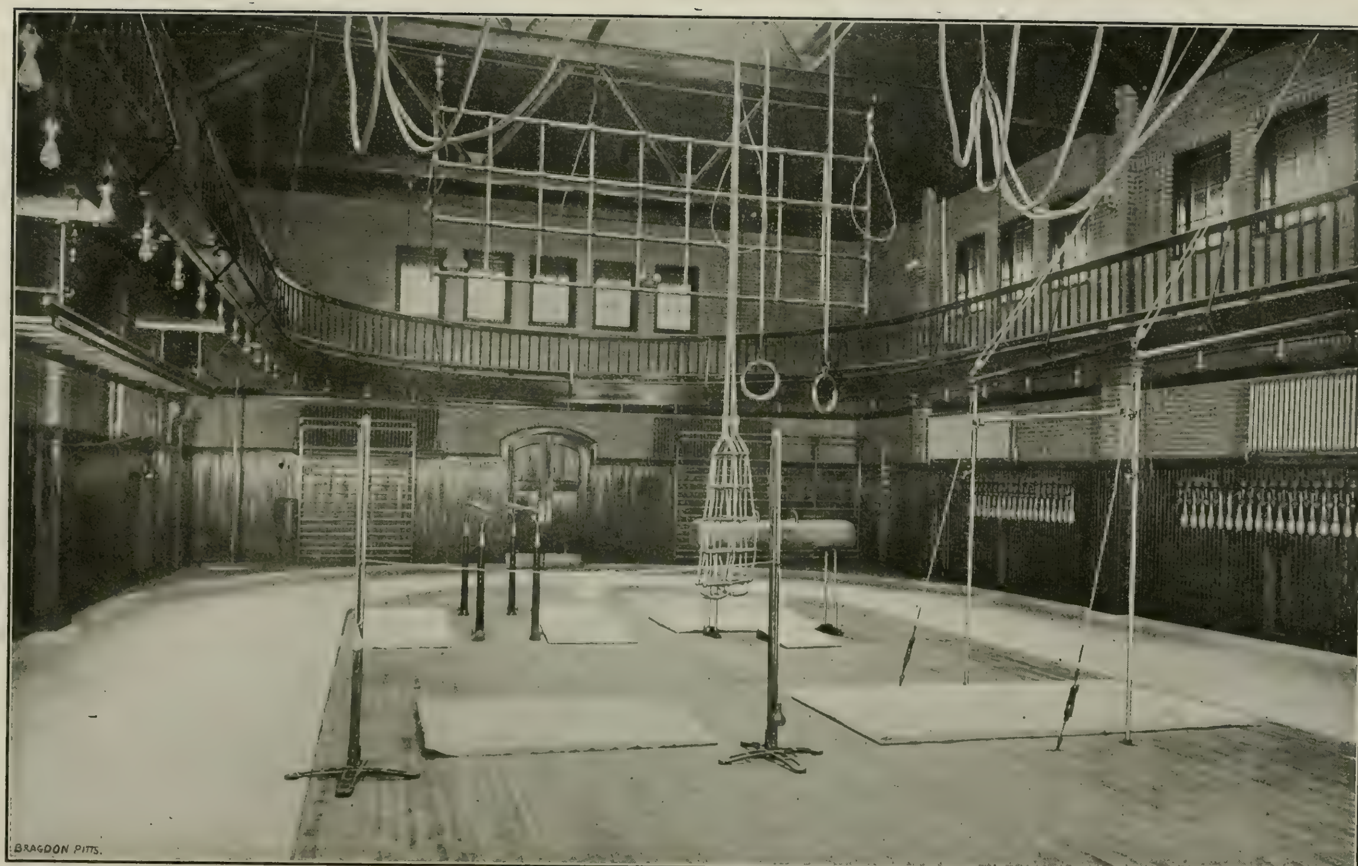


Photo from the School for the Blind, Pittsburgh, Pa.

Sir Francis Campbell, the first educator of the blind to lay sp ecial emphasis upon the importance of physical training for the blind, wrote: "A practical system of education, which has for its object to make the blind independent and self-sustaining, must be based upon a comprehensive course of physical training. A bli nd man who has received mechanical training, general education, or musical instruction, without physical development, is like an engine provided with everything necessary except motive power."

Photo from the School for the Blind, Philadelphia, Pa.

Pyramid Building.

Physical training is fundamental in the education of the blind.

Co-education of the Blind and the Seeing in the Public Schools of Detroit. A class for blind children was opened in Detroit in January, 1912. At the present time there is only one center, with 25 children. This includes, however, two distinct classes: one for those who are blind, and the other for those who have partial sight, with 13 children in attendance. For the details of the education of the blind and the partially blind, in the public schools, see Introduction to this section. Teacher in charge, Fannie S. Fletcher.

State Aid for Blind Babies. The State Board of Education is authorized to make provision for the care, maintenance and instruction of blind babies and children under school age, residing in Michigan, when the parents are unable to properly care for them. The Board may contract with any institution having facilities for such care, maintenance and education (in Michigan or any other state) at a contract price to be agreed upon not exceeding $5 per week per child. Bill passed May, 1913.

Employment Institution for the Blind, Saginaw. Established, 1903; opened November, 1904. Capacity, 100. The original plant cost $75,000; additional buildings to the amount of $10,000 have been recently erected. The principal industries of the men are broom- and whisk-making, and for the women, rug-weaving and chair-caning. Instruction is also given to a few in piano-tuning, typewriting, vocal and instrumental music, and all who wish are taught to read and write the embossed systems. Temporary instruction in vocational training, with maintenance, is free to adults of the state, and permanent opportunities of wage earning employment (with maintenance at cost, if desired) is provided for proficient industrial workers between the ages of 18 and 60 years.

The buildings of this institution are attractively grouped upon a lot of seven acres opposite to which is a twenty acre city park. This abundance of recreational facilities and academic training is mentioned because it is so exceptional among the industrial institutions.

This institution came into being entirely as a result of the efforts of the blind in Michigan, and largely because of the personal efforts and devotion of Mr. Ambrose M. Shotwell, who is today the Librarian and Assistant Superintendent of the Institution. Superintendent, Frank G. Putnam.

Grand Rapids Association for the Blind. This organization was established in 1913. Its purpose is to promote the interests of the blind in the city of Grand Rapids. It was this organization which secured the passage of a state law requiring better attention to the eyes of infants. Secretary, Miss Roberta A. Griffith, 800 Clancy Ave., N. E., Grand Rapids, Mich.

Michigan Blind People's Welfare Association. This organization was started in 1900, and convenes biennially. Both officially, and through its individual members, it did much toward the establishment of the Michigan Employment Institution for the Blind. It was this organization that secured the passage in 1913 of a state law requiring better attention to the eyes of infants. It has also fostered a campaign in conjunction with the Grand Rapids Association for the prevention of blindness. Its constitution states that the object of the association is "to promote in every feasible way, industrial, social, educational, and general welfare of the blind in Michigan." President, Roberta A. Griffith, Grand Rapids; Secretary, Clara M. Willson, Clifford.

Home for Blind Babies, Monroe. Organized, 1911. Supported by voluntary contributions and fees paid by the state for the care of blind babies. Provides for six children. Matron, Mrs. Margaret O'Loughlin.

Libraries for the Blind. Detroit, Public Library, 222 volumes, 212 titles. Books are circulated in Detroit and environs.

Lansing, School for the Blind, 3734 volumes, 960 titles.

Saginaw, Michigan Free Lending Library for the Blind, 2500 volumes, 2100 titles. Books are circulated throughout the state.

MINNESOTA.

School for the Blind, Faribault. Founded, 1864. Capacity, 100. Valuation of plant, $150,000. Annual state appropriation, $35,000. For requirements for admission, course, term, and purpose of instruction, see Introduction to this section. In addition to the usual trades special attention is paid to hand weaving. This school has evolved special looms of its own, and has worked out many of the old Southern blue and white designs. The school owns about 50 acres of land, 10 of which are used for athletics. Superintendent, J. J. Dow.

Summer School for Blind Adults, Faribault. Founded, 1907. Capacity, 15. Through the instrumentality of Superintendent J. J. Dow, the legislature made an appropriation sufficient to try the experiment of using the state school for the blind during ten weeks of the summertime to give instruction to a limited number of blind men. A similar term of four weeks is offered to blind women. This is the first institution for the blind in the United States to utilize its plant in this way. Instruction is given in broom-making, rug- and carpet-weaving, hammock-, flynet- and basket-making, cabinet work and the use of carpenters' tools. Pupils are also taught to read and write, when possible to use the typewriter. The advocates of the

Photo from the School for the Blind, Philadelphia, Pa.

Instruction in Scoutcraft.

Photo from the School for the Blind, Philadelphia, Pa.

With very few exceptions, the boys and many of the girls learn to swim before they leave the school.

summer school plan make no exaggerated claims for the undertaking, but feel that this arrangement has served to give courage to many of those who have attended to try and make a better use of their faculties. Full information relative to requirements for admission can be secured upon application to Superintendent J. J. Dow.

Field and Employment Agency for the Blind, Faribault. Founded, 1913. This activity in behalf of the adult blind in Minnesota has within it the possibility of doing everything that has been contemplated by state commissions for the blind, and we refer the reader to "commissions for the blind" in the Introduction of this section. In addition to the usual activities of commissions the Agency maintains a branch tuning department for the free training of blind piano-tuners in the midway district of St. Paul and Minneapolis. This effort on behalf of the adult blind of Minnesota is carried on under the direction of the State School for Blind Youth. The expenses are met from the support fund of the state school. Director, J. J. Dow.

Higher Education Aid. Aid to the amount of $300 a year is given to a limited number of blind students in universities, colleges and conservatories of music at the discretion and under the direction of the Board of Directors of the Minnesota School for the Blind.

State Aid for Blind Infants. The State Board of Control is authorized to make provision for the care, medical treatment, maintenance and education of indigent blind infants and young children under school age. These children, however, are to be cared for within the state.

Minneapolis Society for the Blind, Franklin Building, *Minneapolis.* Organized 1914. Executive Secretary, Miss Edith Marsh.

Library for the Blind. Faribault, School for the Blind, 4,000 volumes; 566 titles. Books may be circulated throughout the state.

MISSISSIPPI.

School for the Blind, Jackson. Founded, 1846. Capacity, 85. Valuation of plant, $75,000. Annual state appropriation, $61,000 for 1914 and 1915. The school owns 10 acres of land. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, R. S. Curry, M. D.

Library for the Blind. Jackson, School for the Blind, about 1500 volumes, 980 titles.

MISSOURI.

School for the Blind, St. Louis. Founded, 1851. Capacity, 135. Valuation of plant, $412,000. Annual state appropriation, $50,000.

The school owns five acres of land, two of which are available for athletics. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, S. M. Green.

State Aid for College Students. In 1913 a law was passed whereby a blind student, admitted to higher institutions of learning in the state, might be assisted to the extent of $300 a year, to employ persons to read text-books and pamphlets used by such pupil in his studies at the College, University or School. The beneficiary under this act is required to produce evidence that neither he, his parents nor his guardian, is able to pay the expense of providing a reader.

Association for the Blind, 703 Metropolitan Bldg., *St. Louis.* Founded, 1911. Is supported by voluntary contributions. A broom-shop employing 15 men is maintained. Some basket-making is also done. The general purposes of the association are similar to those outlined in the Introduction to this section. The association was largely responsible for the law creating the Commission for the Blind. Executive Secretary, Mrs. Annie F. Harris.

Commission for the Blind. Established, 1915. The law creating the commission is very similar to that creating the commissions in other states and has already been outlined in the Introduction of this section. The first appropriation was $12,500, but coupled with the condition that a like amount be raised from private subscriptions. President, Charles A. Stix, St. Louis.

Home for Blind Girls, 5235 Page Boulevard, *St. Louis.* Founded, 1867. Capacity, 40. Valuation of plant, $80,000. Supported by contributions and proceeds from a small endowment fund. Open to Missouri women without homes who are unable to support themselves. The inmates aid with the housework, and sew and knit. The building is modern and excellently equipped. Resident officer, Mrs. P. S. Pelton.

United Workers for the Blind, 2616 Gamble St., *St. Louis.* Founded, 1913. One purpose of this organization is to provide sick and funeral benefits for the blind of Missouri, although the chief purpose of the society is to secure "pensions for the blind." To further this campaign it issues a monthly paper in ink-print and American Braille, known as *"The World of the Blind."* The membership of this society is limited to blind persons or relatives of the blind. President, Jos. Unterberger, 6033 Westminster St., St. Louis.

Libraries for the Blind. St. Louis, Public Library, 489 volumes; 44 titles. Books may be circulated throughout Missouri and the

Photo from the School for the Blind, Philadelphia, Pa.

A Midsummer Night's Dream.

Final dance of Titania, Oberon, Puck and Fairies, accompanied by the singing of Clowns in the background, given on the lawn one moonlight night in June (1914) before an audience of fully one thousand persons.

Photo from the School for the Blind, Philadelphia, Pa.

"Knee-Deep in June."

If gardening is a good thing for boys and girls with sight, it is infinitely better for those who live in a world of darkness.

adjoining states. In 1912 an embossed catalog was published. Additions are noted monthly in ink-print bulletin.

St. Louis, School for the Blind, 4760 volumes; 569 titles. Books may be circulated throughout the state.

MONTANA.

School for the Deaf and Blind, Boulder. Founded, 1894. Capacity, 25 (blind). This Institution not only has charge of the deaf and blind, but the institution for feeble-minded is under the same management. Valuation of plant, $330,771.05. Annual state appropriation, $83,750. The school owns 490 acres of land, 10 of which are available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see Introduction to this section. Superintendent, H. J. Menzemer.

Library for the Blind. Boulder, School for the Blind, 189 volumes, 56 titles. Books may be circulated throughout the state.

NEBRASKA.

School for the Blind, Nebraska City. Established, 1875. Capacity, 100. Valuation of plant, $200,000. Annual state appropriation, $25,000. The school owns ten acres of land, five of which are used for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see Introduction to this section. Superintendent, N. C. Abbott.

Nebraska Commission for the Blind. Founded, 1913. Appropriation, $2,000 for biennium. The Commission employs a field agent. The activities of this Commission are similar to those outlined in the Introduction to this section. Executive officer, N. C. Abbott.

Library for the Blind. Nebraska City, School for the Blind, 4000 volumes; 1700 titles. Books may be circulated throughout the state.

NEW HAMPSHIRE.

State Home Teaching. In September, 1913, a law was passed appropriating $5,000 for the assistance of the adult blind. The purpose of the law is very similar to that creating commissions for the blind in other states, the only difference being that instead of placing the work under a separate board of management, it was put under the supervision of the State Board of Charities and Correction. Furthermore, instead of opening an industrial institution for the small number of New Hampshire blind, who might benefit by the same, those who need trade training, which cannot be given in the home, are sent to industrial institutions for the blind in neighboring states. Henry

J. Van Vliet, who is in charge of this work, was at one time a student at the Perkins Institution and has twice been a member of the New Hampshire Legislature. Communications concerning this work should be addressed to the State Board of Charities and Correction, Concord, N. H.

Pensions for the Blind. In 1915 a law was passed which provided a sum not to exceed $150 per annum to be paid from the County Treasury to each needy blind person. The New Hampshire law is almost an exact replica of the Ohio law. The reader is therefore referred to Ohio for further particulars upon this subject.

Association for the Blind. Established, 1913, its purpose in general being to further the interests of the blind of the state, and to cooperate, so far as possible, with the efforts carried on at state expense. Secretary, Miss Kate Sanborn, Tilton, N. H.

Libraries for the Blind. Concord, State Library.

Manchester, City Library.

NEW JERSEY.

Commission for the Blind, 54 James St., *Newark.* Established in 1909. The general plan and purpose of the Commission is outlined under "Commission for the blind," in the Introduction to this section. The Commission employs a Supervisor, her Secretary, a bookkeeper, and five traveling home teachers. Weekly lessons in tuning are also given at headquarters. Supervisor, Lydia Y. Hayes.

State Education of Blind Children. New Jersey maintains no institution for the education of her blind children, but sends them, at the expense of the state, to the New York Institute for the Blind, in New York City, and to the Pennsylvania Institution at Overbrook.

Co-education of the Blind and the Seeing in the Public Schools of Newark. A class for blind children was opened in November, 1910. There is an attendance of 17. If children enter this class from neighboring towns a fee of $200 is charged. The plan for educating blind children in the public schools is outlined in the Introduction to this section. Teacher in charge, Miss Janet G. Paterson.

Co-education of the Blind and the Seeing in the Public Schools of Jersey City. A class for blind children was opened in this city in December, 1911. Six children are in attendance. Tuition for children from neighboring cities is $100. For further particulars, see the Introduction to this section. Teacher in charge, Miss Clara M. Croff.

New Jersey State Aid for Blind Babies. New Jersey makes provision of $450.00 a year for the care, medical treatment, maintenance,

Photo from the School for the Blind, Colorado Springs, Colo.

Instruction for the blind in poultry raising has been given with increasing interest since 1907. The Colorado school has developed this phase of training for blind children extensively.

Photo from the School for the Blind, Hartford, Conn.

Outdoor employment furnishes one of the best forms of physical and mental training for the blind.

and education of each blind infant and child under school age, whose parents are unable to properly care for them. These infants may be sent to the Arthur Home for Blind Babies. When blind children are old enough to go to a school for the blind, the state will pay for their tuition while attending such an institution in a neighboring state, at the rate of $400 a year.

The Arthur Home for Blind Babies, Summit. Founded, June, 1909, by the Department of the Blind of the International Sunshine Society. This Nursery can take care of 45 infants. It is supported by voluntary contributions and the fees received from states which have sent blind babies to it. The states which pay for the maintenance of blind children outside of their borders have a reference to such a law under the respective states. Superintendent, Miss Anna Welch.

Home of our Lady of Perpetual Help for the Blind, Bayonne. Founded, 1890, incorporated in 1891, as a boarding and day school for blind and partially blind children, and a home for the aged blind, male and female. This institution receives the blind from any part of the United States. In charge, Sister Rosalie.

St. Joseph's Home for the Blind, Jersey City. The home was opened by the Sisters of St. Joseph of Peace in the fall of 1890, in a private residence. The main building was completed in 1899, at a cost of $65,000. Since that time large additions and improvements have been made. In 1905 a house was purchased adjoining the main building to be used as a residence for men who were for the first time admitted. In 1908 a much larger house was added and occupied by the men as a home, their former building being converted into workshops. In 1909 a third house was purchased, to be used as a school department for children.

Applicants without a home, and having no one to care for them, are admitted to the institution from any state, and it is expected that most, especially the older ones, will remain for life. The state makes no appropriation for the institution, whose maintenance is entirely dependent upon voluntary contributions. The institution is owned by the Sisters and is a monument to their devotion to the welfare of the blind. The male occupants of the Home work at mattress-making, broom-making, chair-caning, hammock-making and weaving. They receive a percentage of their earnings. The younger women are given instruction in sewing, knitting and crocheting. They also make hammocks and prepare the covers for mattresses for that department. The regular branches are taught in the school department, and both instrumental and vocal music are taught. In charge, Sister M. Gertrude.

Camden County Association of Workers for the Blind. Meeting place, Y. M. C. A. Its object is to promote the social, intellectual, and economical welfare of the blind. Secretary, Miss Ethel Robinson, 314 Elm St., Camden, N. J.

New Jersey Association for the Blind, Montclair. Organized, 1911. The purpose of this organization is to cooperate in every possible way with the State Commission for the Blind, and to aid in stimulating further state aid for additional work for the blind. President, Rev. Wm. J. Dawson, D. D.

New Jersey Blind Men's Club, 54 James St., *Newark.* Organized, 1910. Its object is to promote the social and economical welfare of the blind. Secretary, W. J. Addickes.

New Jersey Progressive Blind Men's Society, Free Public Library, *Jersey City.* Organized, 1910. Its object is to promote social, intellectual, and economical welfare of the blind. Secretary, L. P. Schuerman.

Trenton Association of Workers for the Blind, Trenton. Organized, 1911. Object is to promote the social and economical welfare of the blind. Secretary, Mrs. Stanley Crosland, 241 Tyler St., Trenton, N. J.

The Trenton Auxiliary for the Industrial Blind, 346 South Warren St., *Trenton.* Valuation of plant, $3,500. A working home for men where chair-caning and rug-weaving are done. Headquarters called the "Lighthouse." President, Mrs. Harriet Fisher Andrews.

Libraries for the Blind. The Library for the Blind, N. Y. Public Library, and the Free Public Library of Philadelphia loan books to residents of New Jersey. This puts at the disposal of the blind of this state books from the largest collection of embossed books for the blind in the United States.

NEW MEXICO.

Institute for the Blind, Alamogordo. Founded, 1903; opened, 1906. Capacity, 50. Valuation of plant, $50,000. Annual state appropriation, $20,000. Fifty thousand acres of land have been given by the state to this institution, and will ultimately become a source of large income. For school use there are 22 acres of land, two of which are devoted to athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, R. R. Pratt.

Library for the Blind. Alamogordo, Institute for the Blind, 500 volumes, 100 titles. The books may be circulated throughout the state.

NEW YORK.

New York Institute for the Education of the Blind, 34th Street and 9th Ave., *New York City.* Founded, 1831; opened, March 15, 1832. Capacity, 180. Valuation of plant, $1,130,000. Annual state appropriation, $350 per capita; other income from investments. Pupils are admitted without restriction as to residence but are appointed as state pupils from Greater New York and the neighboring counties of the state by the New York State Education Department. They are also appointed as state pupils from New Jersey on application to the Governor, as well as from other localities by arrangement with the Board of Managers. The institution owns several lots of land in New York City. These have been purchased at different times with the expectation of moving the school from its present location, which is next to the Pennsylvania Railroad Station, to a site where there will be more space for new buildings, athletics and recreation. The Board of Managers is, as this goes to press, in the midst of making arrangements for the final location of the new school. In the meantime, the institution still stands upon the historic site which it has occupied for 82 years, and covers about four acres of ground, two of which are available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of institution, see Introduction to this section. Principal, Edward M. Van Cleve.

State School for the Blind, Batavia. Founded, 1865; opened, 1868. Capacity, 180. Valuation of plant, $460,000. Annual state appropriation, $60,000, approximately. The children are admitted from any part of the state excepting the ten lower counties. The school owns sixty acres of land, two of which are available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, C. A. Hamilton.

Catholic Institute for the Blind, 175th Street and University Ave., *New York City.* Founded, 1909. Capacity, 30. It occupies rented quarters, and is supported both by city appropriation and voluntary contributions. Its purpose is the education and care of Catholic blind children, under the direction of the Sisters of St. Dominic. Superioress, Sister M. Bertrand.

Co-education of the Blind and the Seeing, in the Public Schools of New York City. Established, 1909. Total enrollment, 184. There are 18 centers, 16 for blind children (i. e., those with less than 6/60 vision); 1 for blind children of kindergarten age; and 2 centers for children with defective vision (i. e., those who have more than 6/60 vision and less than enough to attend the regular classes with profit).

Pupils vary in ages from 4 to 19 years, and attend all the grades from the kindergarten to the last year in high school. One boy, a strictly "public school product," graduated at the head of his class and is now studying law at Columbia University. For further particulars about the public school method of education see the Introduction to this section. Supervisor, Miss Frances E. Moscrip.

State Aid for College Students. New York has the distinction of being the first state to appropriate public funds to provide readers for blind students attending universities. The law, with an appropriation annually of $3,000, went into effect in July, 1907. The bill was formulated and enacted through the untiring efforts of a blind man, Dr. Newel Perry. The allowance for each student is $300 a year.

New York Commission for the Blind, 105 W. 40th St., *New York*. Established, 1913. State appropriation, 1915-16, $31.640. The commission employs eight home teachers (blind), one field agent (partially blind) and two social service nurses. Home teaching centers have been established in Yonkers, Albany, Glens Falls, Utica, Syracuse, Rochester, and Buffalo, while Industrial Training Centers are located in Albany, Glens Falls, Utica, and Rochester. The activities of the Commission in Brooklyn and New York are in affiliation with the privately supported associations in these cities. All individual cases are referred to the Associations, the Commission availing itself of the organized machinery of these Associations to supplement their work. Material is furnished by the Commission for articles to be manufactured from samples under the direction of the Association visitor. Checks for satisfactory work are made out to individual blind workers by the Commission, and are distributed by the Association. This plan establishes uniform standards and avoids duplication of effort. The Commission acts as a clearing house for sales of work for privately supported associations as well as for individual workers. The fundamental policy of this Commission is outlined in the Introduction to this section. Secretary, Miss Marion A. Campbell.

New York City Pension. "Adult blind persons not inmates of any of the public or private institutions in the City of New York, who shall be in need of relief, and who shall be citizens of the United States, and shall have been residents of the said city for two years previous to the application for such relief" (to quote from the city charter, of June, 1900, section 576), may receive a sum not to exceed $100 "under such rules and restrictions as the Board may deem necessary." The total amount of money distributed in pensions is not to exceed $75,000 annually. This money is distributed twice a year. The first city pension was paid in 1875.

New York Association for the Blind, 111 E. 59th St., *New York.* Founded, 1905. The valuation of the various plants is as follows: The Lighthouse, at 111 E. 59th St., $278,764.60; Vacation Home, at

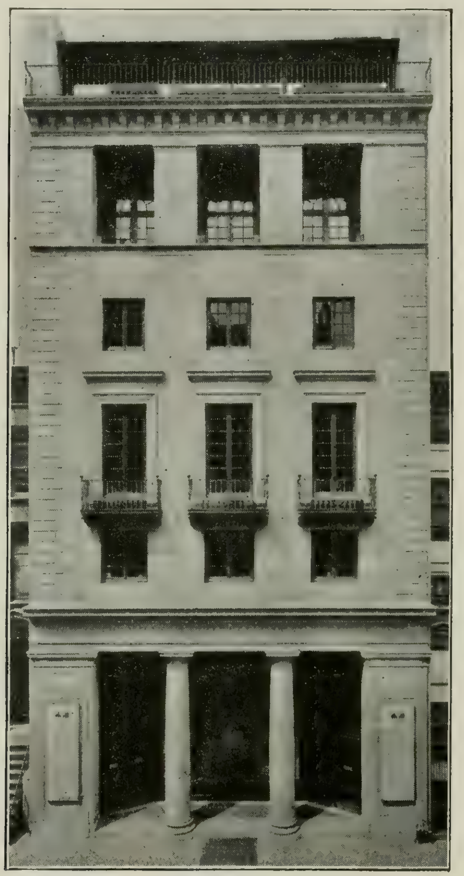


Photo from the New York Association for the Blind.

Headquarters of the New York Association for the Blind, Otherwise Known as "The Lighthouse."

Efforts in behalf of the adult blind are now being made in many states, but in none is there to be found a more completely equipped building than that of the above organization.

Cornwall-on-the-Hudson, $20,000; Tuning School, at 357 E. 49th St., rented building; The Bourne Workshop, 338 E. 35th St., $130,000. All the activities of the New York Association are supported by voluntary contributions and by the income from a $400,000 endowment

fund. The various trades pursued by the beneficiaries defray a considerable portion of the operating expenses, but a large proportion of the outlay is for certain phases of educational work, relief, and social settlement activities for which there is no financial return. There is no restriction as to age, race, or creed of applicants. The Association aims to aid the blind in every possible manner, and its purposes are well exemplified in the Introduction to this section of the *Encyclopedia.* The activities of the Association are carried on all the year round. The Vacation Home at Cornwall-on-the-Hudson, is open from June until September, and for convalescents during the remainder of the year.

The New York Association has established several clubs, the chief purpose of which is to establish pleasant social relations between members of the various organizations. Secretary, Miss Winifred Holt.

Tuning School, 357 E. 49th St. Operated under the auspices of the New York Association for the Blind. Opened in the fall of 1913. There are eight pupils. Their suitability for work admits them. The length of the course depends entirely upon the ability of the pupils, previous training in work, etc. There is a special examination given before certificates are granted. The pupils are examined by a disinterested firm of piano manufacturers who pass upon their ability, etc. Three former pupils are now actively and profitably engaged in private and factory tuning.

Bourne Workshop for the Blind, 338 E. 35th St., *New York.* This workshop is maintained and operated by the New York Association for the Blind. Broom-making is the principal industry, and was begun in 1906. The present building, donated by Miss Emily Bourne, was opened in October, 1912. Valuation of plant, $130,000. Employment can be given to 90 men. There are no restrictions, as to age, race, or creed, for admission, except that applicants must be from New York City or state. There is no boarding house connected with this workshop. Superintendent, De Witt Killinger.

Industrial Home for the Blind of Brooklyn, 512 Gates Ave., *Brooklyn.* This was the first organized movement in behalf of the adult blind in New York State. Founded, October 1, 1893; capacity, 75; valuation of plant, $50,000. Broom-making, chair-caning, and mattress-making are the chief industries. Deficit is made up entirely by private subscriptions. A boarding house is operated chiefly for the benefit of single men, where board is provided at a nominal figure. About one-half of the men avail themselves of the boarding house, and the remainder of the employees live in the neighborhood. Superintendent, Eben P. Morford.

Headquarters for the Blind, Brooklyn Bureau of Charities, 267 Schermerhorn St., Marie Bloede Memorial Bldg., *Brooklyn.* Established, 1914. Valuation of plant, $35,000. Supported by private contributions and by income from the Fox bequest. Available to residents of Brooklyn. The activities of this institution are now carried on in a building which is donated, and might be said to serve as headquarters for much of the social activity in behalf of the blind of Brooklyn. Several clubs of blind people meet here. Besides the weaving and basketry, which are taught to blind women, classes in cooking, etc., are arranged for those who wish to avail themselves of the same. Two home teachers are maintained. Blind children from the public schools in Brooklyn come here Saturday mornings for instruction in sewing, basketry, cooking, physical training and camp fire work. The headquarters are open from September 1st to July 1st. Director, Thomas J. Riley.

Department for the Blind, Brooklyn. Association for Improving the Condition of the Poor. This institution is known as the Exchange and Training Center for the Blind, of the Brooklyn A. I. C. P. It was established in 1912, and is supported by contributions and by income from the Fox bequest. Conducts a workshop and salesroom; chairs are caned and baskets made in the workshop; in the salesroom baskets, rugs and knitted articles are sold on consignment for blind individuals and for students or employees in the workshop. The department also conducts a school where blind young men and women are given advanced training in the use of the typewriter and dictaphone, with a special reference to clerical work in offices and to the transcription of court proceedings. It is also about to establish a school for salesmanship through affiliation with a department of Columbia University. There are 38 blind men in the basket shop; 13 in the typewriting classes, and 13 in the salesmanship class. Director, Charles Bishop Hayes.

New York State Federation of Workers for the Blind. This organization was established primarily to secure legislation necessary for the establishment of a state commission for the blind. Since the creation of the commission the federation has not been very active, but it still exists in case it is needed to help out some other movement in behalf of the blind. President, Charles J. Himmelsbach; Secretary, C. A. Hamilton, School for the Blind, Batavia, N. Y.

Central Council of Workers for the Blind, New York City. This organization is endeavoring to become a clearing house for work for the blind in New York City. President, Charles Bishop Hayes.

New York Blind Aid Association, 442 W. 35th St., *New York.*

Photo from the New York Association for the Blind.

The Bourne Workshop for Blind Men is typical of the buildings in many states devoted to the industrial training and employment of the blind.

Meets at University Settlement. Is an incorporated relief organization for blind members, with stated benefits.

Council of Jewish Women, New York Section. A sub-committee of this Council has taken an active interest in the needs of the Jewish blind since 1906. The Committee provides relief for the indigent Jewish blind of New York City. The National Council of Jewish Women has frequently sent recommendations to the various sections of this organization throughout the country, and in many cities the members of the Council have done effective work in behalf of the blind in their own locality. President of Section, Miss Sadie American.

Blind Babies' Mothers' Association, 66 Broadway, *New York City.* The object of this Association is to unite, in local groups and eventually in national conference, the parents and relatives of blind children, for the betterment of home conditions surrounding the blind; to bring into closer touch the parents and teachers of blind children; to send helpful and instructive literature to parents of the blind in rural communities, and to afford a medium of exchange of ideas among those so scattered; to distribute instructive pamphlets written by eminent specialists on the proper home care of the eyes of young children as a preventive measure and as a first step toward restoration of lost sight; to encourage parents to instil into the minds of their blind children, in their early childhood, a spirit of independence and helpfulness, looking toward useful citizenship. Financial Secretary, F. H. Jerome.

The Brooklyn and Queens Blind Welfare Society, 3 South Elliott Place, *Brooklyn.* Established, 1913. An organization primarily of blind people, formed chiefly to foster legislation or any other activity for the benefit of the blind. The Society meets monthly. President, Edward Tyson, 291 Nostrand Ave., Brooklyn.

The Manhattan and Bronx Blind Peoples' League. The primary purpose of this organization was to secure the passage of a bill creating a State Commission for the Blind. The Association is supported by voluntary contributions and holds monthly meetings from September to June. Secretary, Emily Heil, 379 E 158th St.

Mispah Circle, 516 Gates Ave., *Brooklyn.* This Association was instituted in 1886, its chief purpose being to secure the establishment of an industrial home for the adult blind, which was later accomplished. The Circle now devotes its interest to helping individual blind people. Secretary, Mary Braun, 561 Argyle Road, Brooklyn.

City Home, Blackwell's Island. Maintained by the city for indigent blind men and women. Application is made to the Department of Charities, Bureau of Dependent Adults. The State Charities Aid

Photo from the New York Association for the Blind.

Chair caning can be done by blind men and women of almost any age. It is not necessarily a ''shop industry'' and often proves a very practical means of earning an honest penny at home.

Association has sent a teacher to the blind inmates of the City Home for a number of years. The New York Public Library has for many years sent a teacher for instruction in reading. The New York Association for the Blind has, since its organization, sent a teacher weekly to many of the women in the ward for the blind for instruction in knitting, crocheting and sewing. Monthly entertainments are held for both men and women at which tobacco and candy are distributed.

Home for the Relief of the Destitute Blind, 104th St. and Amsterdam Ave., *New York*. Founded, 1868. Capacity, about 50 men and 50 women. Supported by annual subscriptions and by income from a small endowment. New buildings for the Home are in process of construction. Applicants are admitted from New York City and vicinity. The women occupy themselves with sewing, knitting, and crocheting, and the men re-seat chairs and re-make mattresses. None of the industries is carried on, however, with the idea of furnishing an income for the institution, and they are not obligatory; the inmates choose their own occupations. Matron, Mrs. Margaret J. Brown.

Home for the Blind, 550 Washington Avenue, *Brooklyn*. (The Church Charity Foundation of Long Island.) This home was begun as a private undertaking in 1895, at Maspeth, L. I. However, failing of support under its first conditions, an appeal was made to be received into the Church Charity Foundation of Long Island. This was granted, and in October, 1896, it became one of the institutions of the Foundation, and in May, 1900, was removed to its present location.

It is intended as a home for Christian women of the Episcopal Diocese of Long Island who, owing to blindness and inability of near friends to care for them, are unprovided for. An entrance fee of $250 is required, and it is expected that friends able to do so will further contribute clothing for the inmates, and towards other expenses incurred in times of sickness or death.

Applicants having any real or personal property are required to place the same with the Treasurer of the Church Charity Foundation, receiving therefrom during their life either the whole income, or a portion agreed upon, the principal remaining at their death with the Home Fund of the Foundation.

All members of the Home are expected to take such part as their strength and ability admit in the lighter work of the household, and by habits of neatness and order promote the general health and comfort of the family. Superintendent, Deaconess Agnes L. Hodgkiss.

King's County Almshouse, Brooklyn. The New York Association for the Blind sends a home teacher weekly to the Men's Ward to

furnish instruction in chair-caning and basketry. A teacher is also sent weekly to the women for instruction in sewing and mending. Monthly entertainments are arranged by the Association for the blind men and women at which the sighted inmates are invited to be present.

St. Joseph's Blind Asylum, Staten Island. This is a combined home and school for blind girls and women, under the care of the Sisters of St. Francis. The Home is an integral part of the Mt. Loretto Institution maintained by the Roman Catholic Church. The buildings for blind girls and women have accommodations for 75, and were the gift of Sister Anne. The Institution is maintained by private contributions. Sister Superior, Sister M. Ann.

N. Y. State and N. Y. City Aid for Blind Babies and Children. At the discretion of the Commissioner of Education, blind babies and children not residing in the city of New York, of the age of 12 and under, may be sent to one of the Homes for blind babies and children maintained by the International Sunshine Society, to the Catholic Institute for the Blind or to the Brooklyn Home for Blind, Crippled, and Defective Children, and shall be paid for by the state at the rate of $1.00 per day.

New York City, in 1908, approved a bill committing its blind babies to the Dyker Heights Home, 84th Street and 13th Avenue, Brooklyn, N. Y., and now pays for their maintenance and training at the rate of $1.00 a day. Since 1912 the City Budget has provided for this payment.

International Sunshine Home for Blind Babies, Dyker Heights, 84th St. and 13th Ave., *Brooklyn.* Founded, 1904. Capacity, 31. Supported by voluntary contributions; also by a per capita payment of $1.00 per day for each child from New York City.

A kindergarten, under the management of the public school system, is maintained in the Home, so that children old enough to benefit by this form of training have regular instruction. This provision was made in 1907.

A class for the blind is provided in Public School No. 127, Brooklyn, that the children of this Home physically too frail to enter the New York Institute for the Education of the Blind, New York City, at the age of eight years, may attend the public school daily and yet remain in the Blind Babies' Home for special medical care.

Albany Association of the Blind, Inc., 105 Lancaster Street, *Albany.* Established, 1908. Eight men in the shop; 15 women in the classes. The building occupied as headquarters is owned free of debt by the Association. For men, industrial classes in cane-seating, rug-weaving

and basketry are conducted daily throughout the year, the association being responsible for the instruction and the conduct of the department for cane-seating, the Commission furnishing the machinery and appliances, maintaining the instructor and directing the departments for weaving and basketry.

Industrial classes for women are held on three days of each week from September to July. Monthly social meetings for the blind and their seeing friends are held during the year with the exception of July and August. The Association's work is maintained entirely by voluntary contributions.

Frank L. Frost (blind) is the President, and directs the industrial and social activities. The Association employs a seeing teacher for the women's industrial classes, and a (blind) man as teacher of cane seating.

Buffalo Association for the Blind, 489 Ellicott Street, *Buffalo*. Founded, 1907. Valuation of plant, $10,000. It employs from 15 to 20 men and women, and is supported by voluntary contributions. The industries are broom-making, chair-caning and art-fabric weaving. Applicants outside of Buffalo are also admitted. The services of a home teacher are supplied by the New York Commission for the Blind, which also assists in the sale of goods made by the workers of the Association.

It is interesting to record that the Buffalo Association has been given a Pierce-Arrow automobile arranged to carry 10 to 12 people to and from their work. It is also used for delivery purposes during the day. Manager, J. E. Eldridge.

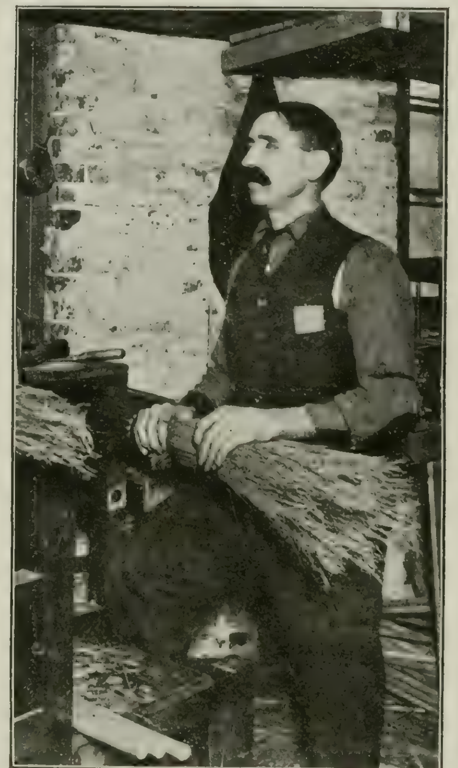
Cayuga County Association for the Blind, Merrifield. This is a social organization of the blind, which meets from time to time, usually in Auburn. President, A. E. Bigelow.

Rochester Association of Workers for the Blind, Inc. Incorporated April 1, 1914. Occupies rented office for administrative work. It maintained a home teacher until September, 1915, when the Commission took over her support and direction. Holds monthly social meetings for blind members and friends, distributes relief and secures employment for blind, maintains a ticket bureau and sells the products of blind labor. Has been active in securing treatment to prevent blindness, and in securing admissions to the State School for the Blind. Has recently secured organization of Advisory Board to conduct, jointly with the Commission, an Industrial Center for instruction in broom making, chair-caning and mattress-making. President, W. Alfred Watson (blind.)

Syracuse Association of Workers for the Blind. Established, 1915.

Photo from the Massachusetts Commission for the Blind.

"Sorting" Broom Corn.



"Winding."

"Sewing."

The first trade for the blind to be introduced into this country was mattress making, distinctly a "shop industry;" the next, and today the most generally pursued, is broom making, which is particularly good, as it enables men of three degrees of mechanical ability to be employed.

Headquarters, Y. M. C. A. Meeting room furnished gratuitously. Supported by voluntary contributions.

Tri-County Association of the Blind, Inc. Headquarters at Glens Falls; covers Saratoga, Warren and Washington Counties. Organized in April, 1915. Incorporated in August, 1915, through the activities of the Commission. Pays traveling expenses of Commission's home teacher for that territory. Works jointly with the Commission, taking responsibility for all social activities and for voluntary assistance in conduct of sales. Treasurer, Mrs. R. W. Sherman.

Utica Committee for the Blind. Established, 1912. Meeting room furnished gratuitously. Supported by voluntary contributions. Home teacher furnished by the New York Commission for the Blind.

National Committee for the Prevention of Blindness. 130 East 22d Street, *New York.* Established, January 1, 1915. Supported by voluntary contributions. See under National work, at the end of this section.

The Matilda Ziegler Magazine for the Blind, 250 West 54th St., *New York.* President and manager, Walter G. Holmes.

For details about this publication, refer to *Magazines,* at the end of this section; also, see p. 270, Vol. I of this *Encyclopedia.*

Libraries for the Blind, Albany, State Library for the Blind. Three thousand, nine hundred and seventy-three volumes; 2,337 titles (books and music). Books may be circulated throughout New York State. An ink print catalog may be had upon application. Through a special appropriation made by the state, the New York State Library prints a number of new titles annually. These may be purchased by other organizations at a nominal price. Librarian, Miss Mary C. Chamberlain.

Auburn, Seymour Library. One hundred and one volumes. The books are circulated in Cayuga and Onondaga Counties.

Batavia, State School for the Blind. Four thousand, seven hundred and fifty-two volumes; 850 titles. The circulation of books is limited to pupils and former students. A printed catalog of the school's publications is available.

Brooklyn, Public Library. Two thousand, two hundred and fifty-five volumes; 1,300 titles. The circulation of books is practically confined to the borough of Brooklyn. A home teacher is employed by the library.

Buffalo, Public Library. Ninety-two volumes. The library has city support only but has loaned books to readers in the county. Printed lists of the books are sent without charge.

New York, Institute for the Education of the Blind. Three thousand, eight hundred volumes; 350 titles, practically all text books. The books are circulated only among the pupils of the school.

New York, Public School Classes for the Blind. Two hundred volumes; 2,500 pamphlets; 170 titles. The books are sent to the different classes for blind children in the public school system of Greater New York.

New York, Public Library, Library for the Blind. Seven thousand, nine hundred and two volumes (music scores not included); 2,426 titles; 5,475 music scores. Books may be circulated throughout New York state, New Jersey and Connecticut, without restriction, and to any part of the United States provided the applicant cannot secure the desired material from a nearer source. Printed catalogs of books and of music will be sent upon request. The embossed catalog is published in five sections, three of books, two of music, each section being printed in the type of the books listed therein. This catalog will be loaned to regularly enrolled readers, or it can be bought at 10 cents a section. The library employs one home teacher who works in Greater New York. Librarian, Miss Lucille Goldthwaite.

Rochester, Public Library. Fifty volumes; 18 titles. Books are loaned to the Rochester Association for the Blind which has headquarters at Reynold's Library.

NORTH CAROLINA.

School for the Deaf and Blind, Raleigh. Founded, 1845. Capacity, 350. Valuation of plant, $250,000 (both departments). Annual state appropriation, $72,500 (both departments). The school owns 35 acres of land, 7 of which are available for athletics. There is a gymnasium. For requirements for admission, course, term and purposes of instruction see Introduction to this section. Superintendent, John E. Ray, A. M.

The North Carolina Association of the Blind, Greensboro. Established in 1909. The general objects of this association are similar to those given under "associations" in the Introduction to this section. At the present time this organization is endeavoring to establish an industrial home for needy blind women. An act of incorporation for such an institution has been granted, and money is being collected for the same. President, H. E. Easley, Greensboro, N. C.

Library for the Blind, Raleigh. School for the Blind. Three thousand, five hundred volumes; 2,500 titles. The books are circulated throughout the state.

NORTH DAKOTA.

School for the Blind, Bathgate. Founded, 1895; opened, 1908; capacity, 36; valuation of plant, $75,000. The school derives its maintenance from an income of $12,000 per year furnished by a grant of land made by Congress to the state for its schools and public institutions. The school owns about 40 acres of land, 6 of which are available for athletics. The location of the school is such that there is unlimited opportunity for recreation, and the pupils frequently go for long walks in the surrounding country. There is a small gymnasium. For requirements for admission, course, term, and purpose of instruction see the Introduction to this section. Superintendent, B. P. Chapple.

State Aid for Blind Infants. The State Board of Control is authorized by a bill, passed in March, 1913, to make provisions for the care, maintenance, and instruction of indigent blind babies and children under school age in an institution inside or without the state, and to provide transportation to and from the same until there shall be established by law an institution within the state for the care of blind children under school age.

Library. Bathgate, School for the Blind. Seven hundred and sixty-two volumes; 300 titles. Books may be circulated throughout the state.

OHIO.

Ohio State School for the Blind, Columbus. Founded, 1837. Valuation of plant, $800,000. Annual state appropriation, $100,000. Capacity, 240. There are nine acres in the whole institution, six of which are used for recreational purposes. There are two gymnasia.

Historically, it is interesting to note that the Ohio School was the first to be established entirely at state expense. Boston, New York, and Philadelphia preceded it by only a few years, but these three owe their establishment to private bequests, which were later supplemented by state appropriations. Superintendent, Charles F. F. Campbell.

Co-education of the Blind and the Seeing in the Cincinnati Public Schools. Classes for blind children were started in the public schools of Cincinnati in 1905. There are five centers, three known as "conservation of vision" classes, with an attendance of 30 children having partial sight (that is more than 6/60 and less than 6/15 vision), one center for five blind children, and one center for blind mentally defective children (4 in attendance). This was the first attempt in America to give blind, mentally defective children special attention in the public

Photo from the Workshop for the Blind, Milwaukee, Wis.

Basket making is one of the oldest industries for the blind in the world. In Europe it may be said to be the "staple" trade of the blind, whereas in America broom making holds that position. Wisconsin has the largest basket shop for the

schools. In the same building there is also provision made for seeing children who are mentally defective. The department is known as the "Special School for Mentally Defective Children." For full particulars of the public school method for training the blind, see the Introduction to this section. Director, R. B. Irwin.

Co-education of the Blind and the Seeing, in the Cleveland Public Schools. Classes for blind children were started in the public schools of Cleveland in 1909. There are four centers for partially blind children, and attendance in these classes is 40. There are four centers for blind children (that is children whose vision is less than 6/60), and the attendance is 33. One of the centers for the blind children is located in the Cleveland Training School for Teachers. This is a fact worthy of attention, for by this arrangement every teacher who passes through this training school has the opportunity of becoming familiar, to a greater or lesser extent, with the possibility of teaching blind children in the public schools. This arrangement means that graduates from the training school in Cleveland become fully acquainted with this method of educating the blind.

One of the biggest problems confronting those responsible for the training of blind children in the public schools is to provide the pupils with trade and industrial training equivalent to that given in residential schools. In 1916 Cleveland began to provide its blind youths, who are capable of benefiting by the same, instruction in pianoforte tuning. The man who gives instruction in tuning has charge also of the 700 pianos owned by the Board of Education so that it is possible for him to give his pupils the opportunity of practising upon nearly every make of piano in every degree of repair. This is a unique event in the education of the blind in America, and will go a long way toward placing the public school method of training on an equality with that of the best residential schools. Director, R. B. Irwin.

Co-education of the Blind and the Seeing, in the Toledo Public Schools. Work of this kind was started at Toledo in February, 1915. There are two centers with 18 pupils, one class providing for children with partial vision and the other for blind children.

In January, 1915, the Board of Education of Cincinnati, and of Toledo, requested Robert B. Irwin, the supervisor of the education of the blind in Cleveland, to conduct this form of education in Cincinnati and Toledo. This cooperation among the three cities has been of great value, as it has resulted in a practical co-ordination and unification of the work, and there can be little question that this "so-called public school experiment" is being carried on most progressively in Ohio. In 1916 a visitor was employed to coordinate the training of

the blind children in their homes with that received in the school. Director, R. B. Irwin.

State Aid for College Students. In May, 1913, a law became effective in Ohio whereby blind pupils studying in any college, university, or technical or professional school authorized by law to grant degrees, may receive assistance for defraying of the expense of readers (subject to the approval of the State Board of Administration), upon the recommendation of the state school for the blind. It is regrettable to have to record that the Ohio law, unlike the New York law, does not specify any fixed amount to be allowed each student.

Ohio State Commission for the Blind. Founded, 1908. Headquarters, Columbus. The purpose of the Commission is similar to that indicated in the Introductory matter of this section, under the heading "Commissions for the Blind." The Ohio Commission was the first to employ a staff of nurses to seek and assist those with defective vision. The Commission cooperates with a large corps of ophthalmologists who give gratuitous advice to those who are unable to secure competent medical assistance. The Commission also succeeded, in 1915, in having a law passed which not only requires the prompt reporting of ophthalmia neonatorum (see **Blindness, Prevention of**), to the State Board of Health, but also makes it obligatory for that Board to send a trained nurse to a family in which a case of ophthalmia neonatorum is found, where parents are unable to provide proper care. As only $5,000 was granted for this home nursing service—for newborn infants with "sore eyes"—the nurses of the Commission for the Blind besides giving their time to other cases of defective vision, cooperate for the first two years with the Board of Health in looking after a case of ophthalmia neonatorum that cannot be reached by the Board of Health nurse.

The Commission employs nine blind home teachers who give instruction in sewing, knitting and crocheting, as well as instruction in reading and other occupations that help to make life more cheerful. Furthermore, the Commission provides raw material to blind women who, in their homes, are able to do acceptable work. A market for the articles made by these women is found by cooperation with public-spirited merchants who give, without charge, space in their stores for the sale of this work. The goods are also sold in private homes by traveling saleswomen and at women's clubs.

The Commission operates a trade-training department in which instruction is given in broom-and basket-making, and when a man is able to conduct either industry in his own home he is helped in the

purchase of tools and raw material, and is assisted to find a market for his work. Acting Executive Secretary, Miss Frances Reed.

Pensions for the Blind. Ohio appears to be the first state that attempted to put into operation a state-wide distribution of monetary relief for the blind. The first law was a modification of the poor laws of 1898. In 1904 a Pension Law for the Blind was passed, to be administered by the probate court, with a per capita allowance of $100. This enactment was, however, declared unconstitutional by the Supreme Court, upon the ground of "class legislation." In 1908, the Carrol bill "For the Relief of the Needy Blind" was passed (Sec. G. C. 2962-70). The bill provided for a commission in each county which might grant such sums as it deemed necessary, up to $150 a year (payable quarterly). The conditions of payment are: 1. Blindness (degree not defined); 2. Residence in the county for one year; 3. Must have become blind while a resident of the state, or have been a resident at the passage of the act; 4. Must be *needy* and one who, unless granted this relief would become a charge on the public, or on those who by law are not required to support him or her. This was declared constitutional by the Supreme Court September 30, 1913 (89 O. S. 351) on the ground of the need of a class for the poor. The earlier statute gave relief to blind persons regardless of whether they possessed means or not. This law provides for relief only when they would otherwise become public charges.

In 1913 the Carrol bill was amended, abolishing the County Blind Relief Commissions and transferring their powers to the County Commissioners, in whose hands the distribution of the relief now rests.

The Ohio Law was evidently drawn hastily and has not given entire satisfaction either to the blind or to their friends, and it is hoped that other states wishing to pass such laws will study the matter carefully before action is taken. To mention only one of the difficulties, we refer to the fact that no attempt is made to define the term "blind," which leads to considerable confusion. According to the latest reports, nearly 4,000 blind people are securing financial assistance under this law, representing a total expenditure of county funds of approximately $400,000 per annum.

The Cincinnati Library Society for the Blind. Through the efforts of Misses Georgia D. and Florence B. Trader, the Cincinnati Library Society for the Blind was organized in 1901. Weekly readings are held by volunteers, who read books and magazines not published in types for the blind, a special entertainment is given once a month, and classes in reading and writing embossed type and in needle-work are held each week. The blind are also visited in their homes, and helped

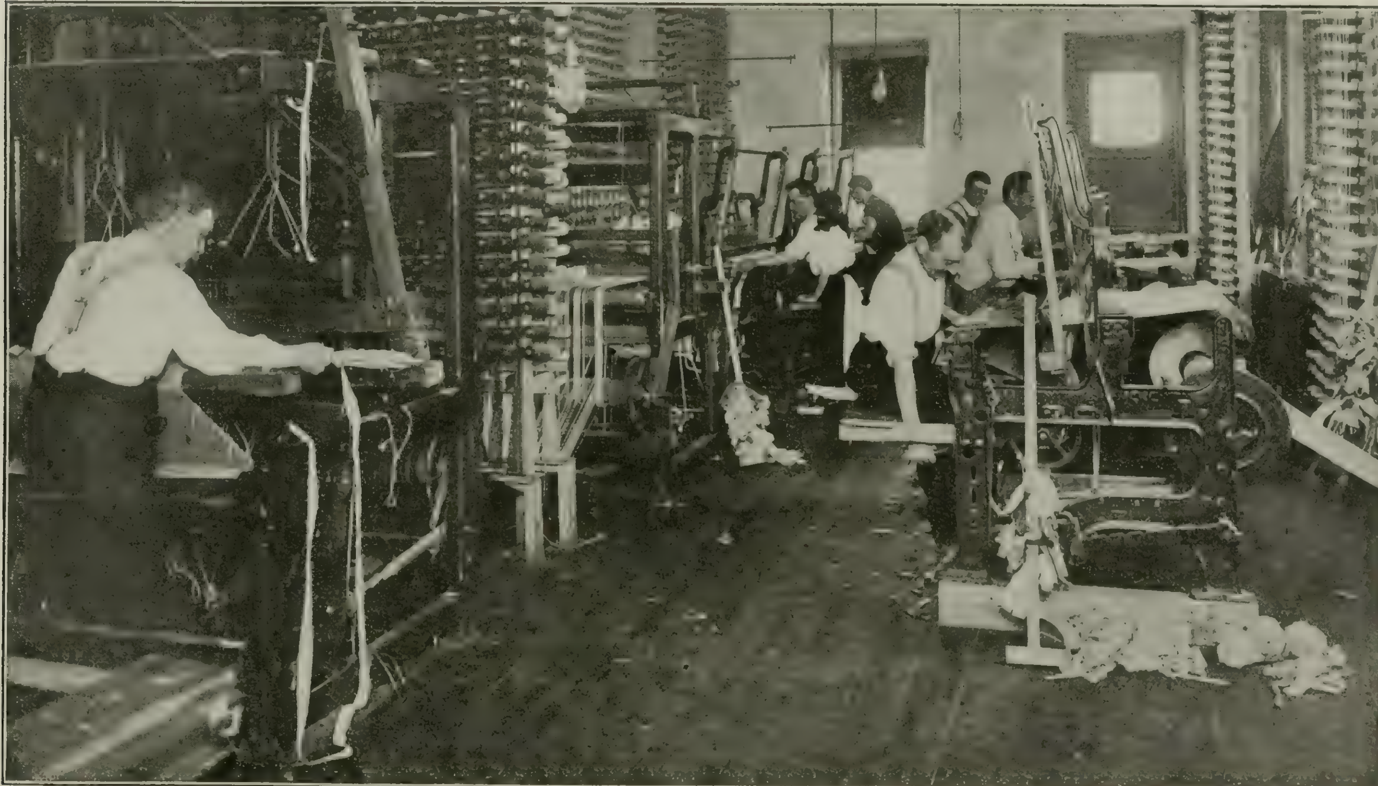


Photo from the Massachusetts Commission for the Blind.

Artistically designed hand-woven rugs were first manufactured by the blind as a commerical product in the Experiment Station of the Massachusetts Association for the Blind. This shop, in 1906, was taken over by the State Commission for the Blind and today is typical of similar work in several states.

in many ways; they are given medical aid, clothing, tickets to entertainments, etc. The Ohio Traction Co. furnish the Society a liberal supply of tickets so it is possible for the blind to enjoy the privileges of the Library.

Through the efforts of the Society, a department for the blind was opened in the public schools in September, 1905.

The Society owns about 2,200 volumes, and circulates them throughout the United States and Canada. During the year 1914, 6,182 volumes were distributed in this way. Directors, Misses Georgia D. and Florence B. Trader.

Clovernook Home for the Blind, Mt. Healthy. After working among the blind for two years, the Misses Georgia D. and Florence B. Trader realized the need of a home for blind women. March 11th, 1903, the late Wm. A. Procter gave the home of the poets, Alice and Phoebe Cary, for this purpose. It is a brick house of seven rooms on a farm of 26 acres, located at Mt. Healthy, eight miles from Cincinnati. In October of the same year, Mr. Procter built a three room cottage for the gardener and the only blind male inmate—a broom-maker—who used a part of the barn for his shop. In May, 1907, the weaving industry was started. It also had its beginning in the barn, where the women worked, until October, when they moved into a beautiful shop, the gift of Mrs. Thomas J. Emery and Prof. Philip Van Ness Myers.

That Clovernook might meet the needs of a greater number, a large cottage was erected and dedicated May 31st, 1913. With this building, and the small home, twenty-two blind women are given roomy and comfortable accommodations.

During the summer of 1913, Prof. Philip Van Ness Myers fitted up a small building where a trial might be made of printing books in embossed type.

The women all help with the house-work. Those who are not able to work in the weaving or printing shops, make fancy articles. They are given one third the sale price of their fancy work, and are also paid for their work in the shops.

Weekly readings and monthly entertainments are given, they are furnished with theatre and symphony tickets, and are taken to other places of amusement.

The home is open all the year. It is supported entirely by voluntary contributions and the sale of products made by the women. The home was primarily intended for homeless blind women of Ohio, but applicants from other states are favorably considered if there are vacancies. An entrance fee of $300.00 is expected from all applicants

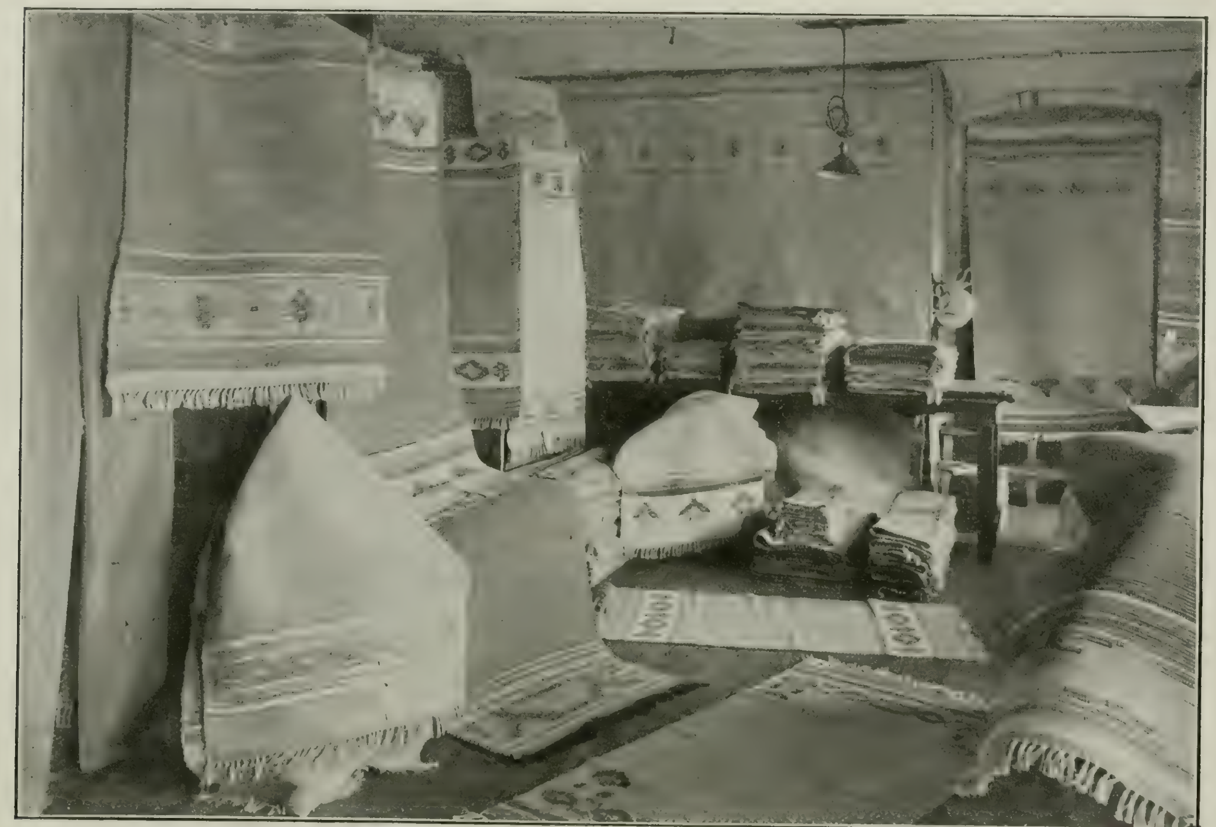


Photo from the Massachusetts Commission for the Blind.

Sample rugs at the Massachusetts Commission for the Blind. These rugs are sold in the best stores of the United States because of the excellence of their design and workmanship, and not because they were made by the "poor blind."

who are able to pay. Trustees, Misses Georgia D. and Florence B. Trader.

The Cincinnati Association for the Welfare of the Blind. Workshop, 1506-1508 Bremen Street. Established, 1911. Capacity, 30. The Association occupies rented quarters, and the principal industries are broom and basket-making. Some mops are also made. This shop was established as a result of the efforts of the Cincinnati Association for the Welfare of the Blind. Director, Charles F. Kuhn.

Cleveland Society for the Blind, 612 St. Clair Avenue. Founded, 1906. This society endeavors to assist the blind along the general lines indicated in the Introduction to this section, under "typical commissions and associations for the blind." It is supported entirely by voluntary contributions. The Society operates a broom shop, which gives employment to 25 blind men. There is also a small amount of weaving carried on by blind women. The Society cooperates effectively with the State Commission for the Blind in an effort to create as large a market as possible for the sale of the work of the blind. Through active sub-committees it does many helpful things for the blind children who are receiving instruction in the public schools; it has also organized clubs for the adult blind Secretary, Mrs. Eva B. Palmer.

Howe Publishing Society for the Blind. Founded in 1911. The purpose of this organization is to provide the blind with current literature. Most of the work is done by totally blind workers. The books produced by this Society are sold to libraries, institutions for the blind and individuals throughout the entire country. President and director of the work, Robert B. Irwin, 1443 E. 3d St., Cleveland, Ohio.

Dayton Association for the Blind. Founded, 1907. Its purpose is similar to that of associations for the blind described in the Introduction to this section. For a time, this organization operated a shop in which broom-making was carried on, and it is a particularly noteworthy fact that as a result of its efforts, quite a number of positions have been secured for the blind in factories where the seeing are regularly employed. The most notable example of this phase of the work is the employment of three blind girls in the factory of the National Cash Register Company, who have been on the pay roll of that concern for the past seven years. Positions for men in several other concerns have also been found.

The Association took an active part, in conjunction with the Cleveland Society for the Blind, in bringing about the establishment of the Ohio State Commission for the Blind. As soon as the work of the Commission was well organized the Association became less active,

but has cooperated very closely with the Commission in work for the blind in Dayton. President, Mrs. Eugene F. Barney.

Libraries for the Blind, Cincinnati. Library for the Blind, 2,200 volumes. Books are circulated throughout the United States and Canada. A New York Point catalog is available at ten cents a copy.

Cleveland, Public Library. Six hundred eighty-nine volumes; 436 titles. Books may be circulated throughout the United States.

Columbus, State School for the Blind. Has on hand all the books published by the American Printing House in New York Point. Books may be circulated throughout the state.

OKLAHOMA.

School for the Blind, Muskogee. Founded, 1908. Capacity, 120. Valuation of plant, $150,000. Annual state appropriation, $40,000. The school owns 25 acres of land, 2 of which are used for athletics. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section.

Library for the Blind, Muskogee, School for the Blind. Two thousand volumes. Books may be circulated throughout the state.

OREGON.

School for the Blind, Salem. Founded, 1874. Capacity, 50. Valuation of plant, $30,000. Annual state appropriation, $12,000. The school owns ten acres of land, one of which is available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, E. T. Moores.

Workshop for the Adult Blind, Portland, 11th and Davis streets. Established, 1913. Capacity, 20. Instruction is given in hammock-making, piano-tuning, and chair-caning. At the present time, the Shop is maintained by the Educational Department, City of Portland, in connection with its trade school for the seeing. The work is in charge of J. F. Meyers, who is himself blind.

Libraries for the Blind, Portland, Library Association. One hundred and fifty-four volumes; 73 titles. Books may be circulated throughout the state.

Salem, School for the Blind. Six hundred volumes; 240 titles. Books may be circulated throughout the state.

PENNSYLVANIA.

Institution for the Instruction of the Blind, Overbrook, Philadelphia. The education of blind children in Philadelphia was begun in 1832

when Julius Friedlander taught at his own residence and at his own expense Sarah and Abraham Marsh, two Philadelphia children. Having thus demonstrated the possibilities in educating the blind, a meeting of the citizens of Philadelphia was held, a committee was appointed, a constitution was soon adopted, and a Board of Managers appointed, which held its first meeting March 5th, 1833. At this meeting, Mr. Friedlander was appointed ''Principal Instructor,'' and on the 25th of March, 1833, the Pennsylvania Institution for the Instruction of the Blind was opened on Twelfth Street, above Race, with four Philadelphia pupils. It is significant that in that early day, the managers should anticipate so accurately the character of the work to be done in the Institution as to designate it as an ''Institution for the Instruction of the Blind.'' ''The system of instruction adopted was that which the celebrated and benevolent Valentin Haüy so successfully carried into effect in several establishments of a similar character in Europe.''

On Jan. 27th, 1834, the Legislature granted the necessary articles of incorporation.

In April, 1834, the Institution was removed to two large buildings on 13th street, above Race.

The cornerstone of the building at 20th and Race Streets, which housed the school for 63 years, was laid September 10th, 1835, Andrew Jackson then being President. This building was opened on Oct. 27th, 1836, with an exhibition and concert by the pupils.

In January, 1899, the school was moved to its present site at Overbrook, within the limits of the City of Philadelphia. Subsequent purchases have increased the original 27 acres to about 30 acres. The site has been acquired at an approximate cost of $200,000; the buildings and furnishings have cost about $300,000; the present (1915) valuation of plant and equipment is $679,868.93. The buildings are in the Spanish Mission style of architecture so common in Southern California. This construction provides buildings unusually free from danger from fire, while they admit a maximum of light and air. A tuition fee of $350 is charged those who are able to pay it, although in practice but little is realized from this source. The school is supported from the income of endowment funds and by a per capita appropriation of $300 for pupils from the state of Pennsylvania. Pupils from Delaware and southern New Jersey are also educated here at the expense of their respective states.

We have given this full account of the beginnings of the Pennsylvania Institution because the Philadelphia, New York and Boston schools were the first three to be established in America. Furthermore,

Photos from the Home for the Blind, St. Louis, Mo.

"Homes" for the homeless are as much a necessity for the sightless as for the seeing. In states where "pensions" are given to the "needy blind" accommodation can often be found with some private family in the community. A small well-regulated home is one of the best methods of caring for the homeless, the aged, or the infirm blind.

the Pennsylvania Institution was the first to give up its congested city quarters and move out to the suburbs. Since the removal of the Philadelphia Institution in 1899, the schools in Baltimore and Boston have also given up their city buildings and have re-built in the suburbs. The New York City Institution is likewise preparing to make a similar change.

The Overbrook school is able to house nearly 200 students. Although located within the limits of the city of Philadelphia, the school possesses ample grounds for recreation purposes, approximately eleven acres being given over to athletics, and fully two to gardens for the use of the school children. Historically, it is important to note that in addition to a well-equipped gymnasium, this school was the first in the United States to install a fine swimming pool and bowling alley, which were opened in 1899. The requirements for admission, course, term, and purpose of instruction are outlined in the Introduction to this section. In addition to furnishing everything required by a typical school for the blind, this school lays considerable emphasis upon the training of pupils who are qualified to become teachers, and it is interesting to note that graduates from this institution are serving as teachers in quite a number of other American institutions for the blind.

Another interesting effort of the school is the maintenance of what has been called a "field officer." Liborio Delfino, who is himself blind, was the pioneer in this form of activity in America. He has visited many former pupils of the institution in their own homes and has called upon almost every blind man and woman in the state. He is constantly visiting prospective pupils and helping graduates who need friendly advice and encouragement in establishing themselves. Superintendent, Olin H. Burritt.

Salesroom and Exchange for the Blind, 204 So. 13th St., *Philadelphia.* Opened, 1910. We mention this interesting establishment immediately after the School for the Blind, for it is supported and carried on by the Pennsylvania Institution for the Instruction of the Blind. It is at this place that Mr. Liborio Delfino, who is in charge, has his headquarters. In the salesroom are sold many articles made by the blind; here also orders for tuning, chair-caning, etc., are taken. In this same building are housed the books of the Department for the Blind of the Free Library of Philadelphia, and of the Pennsylvania Home Teaching Society, which will be mentioned later.

Western Pennsylvania Institution for the Blind, Pittsburgh. Founded, 1888. Opened in 1890. Capacity, 130 pupils. Valuation of plant, $600,000. Annual state appropriation $360 per capita; there is also an income from endowments. The school owns five and one-half

acres of land, two of which are available for recreational purposes. There is a gymnasium and swimming pool; also a special kindergarten building. This school is unique in respect of location in the midst of what might be termed the intellectual center of Pittsburgh, the pupils being within walking distance of the University of Pittsburgh, the Carnegie Institute of Technology, the Carnegie Library and Museum, Soldiers Memorial Hall, and the largest and newest high school of the city. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, Thomas S. McAloney.

State Aid for Blind Infants. The State Board of Education is authorized, in virtue of a bill passed, May, 1913, to make provision for the education of blind children under eight years of age residing in Pennsylvania when the parents are unable to educate them properly. The board may contract to this end with any nonsectarian institution in Pennsylvania or elsewhere, established for the education of the blind, at a cost not to exceed $1.00 a day, the money to be paid out of the state school fund. The Act of 1913 was so amended by the Legislature of 1915 as to permit the State Board of Education to waive the age limit of eight years in such cases as seem to warrant it by reason of physical or mental defects.

The Pennsylvania Working Home for Blind Men, 3518 Lancaster Av., *W. Philadelphia.* Founded. 1874. Capacity, 200. At the present time, there are 117 beneficiaries, about half of whom live in the institution. Valuation of plant, $202,000. Annual state appropriation, $17,500, and from the city of Philadelphia, $5,000. Applicants must be at least 21 years of age, in good physical condition, and residents of the state of Pennsylvania for at least one year. The Home prefers not to admit men over 45 years of age. The principal industry is broom-making, although a small amount of rag carpet is made, and a limited number of chairs are caned annually. About one-third of the men live or board outside of the institution.

As its name implies, the institution maintains a boarding home for men who wish to live in the institution and receive board at a nominal fee. All inmates who have worked industriously at this institution but who are no longer able to labor are provided with a permanent home in the boarding department or "Retreat" until their death. However, no part of the appropriation by the State or City is used for the care of these individuals; these expenses being met by an income from an endowment and by private subscriptions.

We call the readers' attention to this institution as the one to which we referred in the Introduction to this section, since it was the first

extensive effort to establish a workshop for adult blind men entirely independent of any of the older institutions for the training of blind youth. It came into being as a result of industrial experiments made by the Philadelphia school, and after long and persistent agitation by Mr. Chapin and the management of the school. Hinmon H. Hall, a man who lost his sight in adult life, was the superintendent of the institution from its inception in 1874 until his death in 1890. He had much to do with the early experiments and the success of the institution. Superintendent, Frederick H. Mills.

Pennsylvania Industrial Home for Blind Women, 3827 Powelton Ave., *W. Philadelphia.* Founded, 1869. Capacity, 70. Valuation of plant, $89,000. As we have before intimated, it is not easy to draw a line between some so-called "homes" and "workshops." This institution is unquestionably more a Home than a Shop, which we have previously pointed out more closely approximated a factory. In it every inmate able to work is busily employed four and one-half hours a day, some with various forms of fancy work, others with the re-seating of chairs or the weaving of rag carpet and rugs. As in the case of the Working Home for Blind Men, those who have become aged and infirm while in the institution are provided for. The Industrial Home receives no state aid; it is supported entirely by interest from endowment and by private subscriptions.

The Home receives adults only and without regard to their religious denominations. It prefers not to admit women over 50 years of age. Superintendent, Miss Ada V. Harry.

The Pennsylvania Home Teaching Society and Free Circulating Library for the Blind. Headquarters, Witherspoon Bldg., *Philadelphia.* Founded, 1882, by the late William Moon, the blind inventor of the Moon embossed type, and his daughter, Adelaide E. C. Moon. The Society was reorganized in 1898; incorporated in 1901; received state aid in 1905. It now receives $4,000 a year from the Legislature. The organization also enjoys an income from an endowment fund and from annual donations. The 3,764 volumes which the Society owns are valued at $3,500. With the exception of 710 volumes, which are in the Carnegie Library at Pittsburgh, all the books are deposited with and circulated by the Free Library of Philadelphia. Until November, 1915, four home teachers only were employed in the work of the Society, two of these confining their attention to Philadelphia, one to Pittsburgh, and the third working in other parts of the state. Six additional teachers have since been engaged. Seven of these are totally and three partly blind. The books owned by the Free Library of Philadelphia are circulated only in the city, those in the Home Teaching Society are

utilized throughout the country. The Pennsylvania Society was the first home teaching society to be established in America, and the son of the founder, Dr. Robert C. Moon, served as the secretary of the organization until his death in February, 1914. For further particulars of the Moon alphabet, see page 259, Vol. I of this *Encyclopedia*. Secretary, Mrs. Isabel W. Kennedy.

Blind Relief Fund of Philadelphia, 617 Witherspoon Bldg. Founded 1908. There are no overhead expenses, no state or city aid, but the fund is secured from voluntary contributions. The purpose of the organization is to give an annual outing to the blind, and occasionally financial assistance to the needy blind. Up to the present time, however, only a small fund has been realized.

Chapin Memorial Home for the Aged Blind, 6713 Woodland Ave., *Philadelphia.* Founded 1906. Capacity, 30. Valuation of plant, $35,000. Endowment fund, $65,000. Supported entirely by donations and income from endowment. Applicants may be of either sex, from Pennsylvania, New Jersey or Delaware, and elsewhere if there are vacancies. An admission fee of $300 must be paid by those over 75 years of age, and $500 by those between 65 and 75; in every case burial must be provided for. This Home was founded by 12 former pupils of the Pennsylvania Institution for the Blind, because aged blind persons were excluded from all nonsectarian homes for the aged, as well as from nearly all sectarian homes. Matron, Mrs. Agnes B. Reibold.

Pennsylvania Association for the Blind, Liberty and Second Avenues, *Pittsburgh.* Founded, 1910. This organization does not own the building in which it maintains its headquarters. Annual state appropriation, $2,500. The City of Pittsburgh gives $15,000 towards the maintenance of the workshop. Membership dues and donations are also received. This organization aims to carry on the activities outlined in the "typical Association for the Blind" referred to in the Introduction to this section. Instruction is given at the homes of blind women in sewing, knitting, and crocheting, and material is provided for the making of articles which the organization undertakes to sell. The merchants in Pittsburgh have contributed space for the sale of this work from time to time, although no permanent counter is used, as in New York City and Ohio. In addition to this, club women give substantial aid in the sales, and each year at the Pittsburgh Industrial Exposition, which is held for six weeks in the autumn, the Association finds a good market for the home work. Executive Secretary, W. W. Stamm.

Pittsburgh Workshop for the Blind, Liberty and Second Avenues,

Pittsburgh. Founded, 1910. Receives $15,000 from the city of Pittsburgh, and some contributions from private sources. The principal industries are broom-making and chair-caning, and rug-weaving. This shop is conducted under the supervision of the Pennsylvania Association for the Blind, which has its headquarters in Pittsburgh, and gives employment to 40 men. Superintendent, Wm. H. Long.

Blind Women's Progressive Club. Organized, 1912. Incorporated, 1914. Interested in establishing a home for indigent and aged blind women. Funds secured from membership fees and contributions. The active members are blind and there are one-half as many associate members having sight. This organization is affiliated with the Congress of Women's Clubs. President, Miss Elizabeth Johnson.

The Society for the Promotion of Church Work Among the Blind. Organized in Philadelphia in 1903. Has defrayed the expenses of embossing parts of the Book of Common Prayer, Words and Music of the Hymnal in Braille, Holy Communion in Moon. Cooperates with churches, missionary societies, etc. Employs a blind visitor. Also furnishes guides for those unable otherwise to attend church. Treasurer, Rev. W. Arthur Warner, 533 Arch Street, Philadelphia.

Libraries for the Blind, The Free Library of Philadelphia. The Free Library of Philadelphia and the Pennsylvania Institution for the Instruction of the Blind jointly rent the building at 204 South 13th Street, which is used for library purposes and provides a place for the Salesroom and Exchange, a striking example of practical cooperation. Five thousand, five hundred and sixty-nine volumes; 1,062 titles. Books purchased for the Free Library are circulated only within the city limits, but those belonging to the Pennsylvania Home Teaching Society (see reference to this organization above), are sent anywhere in the United States, except where borrowers may be supplied from a nearer source. Embossed lists of the books are loaned free. Librarian-in-charge, Mrs. Liborio Delfino.

Philadelphia, Overbrook, School for the Blind. Nineteen thousand, nine hundred and forty-one volumes; 1,175 titles. Books are circulated anywhere in the United States when they cannot be secured elsewhere. A list of all publications in American Braille can be bought for 9 cents.

Pittsburgh, Carnegie Library. Two thousand, six hundred and twenty-seven volumes; 1,052 titles. Books are circulated through Western Pennsylvania. Ink print catalog, 10c; Braille and Moon lists loaned to readers.

Pittsburgh, School for the Blind. One thousand volumes. Books loaned in Western Pennsylvania.

RHODE ISLAND.

Home Teaching for the Adult Blind. Home teaching at state expense was begun in Rhode Island in 1904, and is now conducted under the direction of the State Board of Education. Two teachers are employed. The instruction given is similar to that provided by other home teaching organizations generally.

State Aid for Blind Infants and Youths. Rhode Island makes provision of $1.00 a day for the care, medical treatment, maintenance, and education of blind infants and children under school age whose parents are unable properly to care for them. These infants may be sent to a nursery for blind babies outside of the state. When blind children are old enough to go to a school for the blind the state will pay for their tuition while attending such institution in a neighboring state.

SOUTH CAROLINA.

School for the Deaf and Blind, Cedar Spring. Founded, 1849. Capacity, 100 blind; valuation of plant, $155,000 (both departments). Annual state appropriation, $35,000 (both departments). The school owns 150 acres of land, 10 of which are available for athletics. There is a gymnasium. For requirements for admission, course, term and purpose of instruction, see the Introduction to this section. Superintendent, N. F. Walker.

Library for the Blind, Cedar Spring, School for the Blind. One thousand volumes; 400 titles. Books are circulated throughout the state.

SOUTH DAKOTA.

School for the Blind, Gary. Founded, 1900. Capacity, 50. Valuation of plant, $70,000. Annual state appropriation, $15,000. The school owns 20 acres of land, 14 of which are available for athletics. There is a gymnasium. Requirements for admission, course, term, and purpose of instruction are similar to those outlined in the Introduction to this section except that pupils are admitted up to 30 years of age. This school has the unique feature in this country of having always had a woman as superintendent. Superintendent, Mrs. Lelia M. Curl.

State Aid for Blind Infants. South Dakota makes provision of $1.00 a day for the care, medical treatment, maintenance and education of blind infants and children under school age whose parents are unable to properly care for them. These infants may be sent to a nursery for blind babies outside of the state. When blind children are old

enough to go to a school for the blind, the state will pay for their tuition while attending such institution in a neighboring state.

Libraries for the Blind, Gary, School for the Blind. One thousand three hundred and thirteen volumes. The books are circulated only among pupils of the school.

TENNESSEE.

School for the Blind, Nashville. Founded, 1844. Capacity, 225. Valuation of plant, $230,000. Annual state appropriation, $35,000. The school owns 10 acres of land. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, John V. Armstrong.

Home for Blind Women, Nashville. Founded, 1903. Capacity, 20. Supported by donations and state aid, the amount of the latter for the past two years being $135.00 per capita, per annum. The women help with the housework. Applicants must live in Tennessee, must be of good moral character and have no contagious disease. If possessed of any property, it must be given into the general funds. The Home is under the auspices of the Fear Not Circle, King's Daughters.

Library for the Blind, Nashville, School for the Blind. Six thousand volumes. Books are circulated throughout the state.

TEXAS.

School for the Blind, Austin. Founded, 1856. Capacity, 260. Valuation of plant, $300,000. Annual state appropriation, $85,000. Recent appropriation of $300,000 for new buildings. The school owns 75 acres of land; all that is needed is used for athletics. There are two gymnasia and a swimming pool. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, E. E. Bramlette.

Library for the Blind, Austin, School for the Blind. Seven thousand, five hundred volumes; 600 to 800 titles. Books are circulated throughout the state.

UTAH.

School for the Deaf and the Blind, Ogden. Founded, 1896. Capacity, 50; attendance, 35 (blind). Valuation of plant, $300,000 (both departments). Annual state appropriation, $50,000. When the state of Utah was created the enabling act called for the creation and maintenance of a school for the deaf and the blind and presented 100,000 acres of land as auxiliary aid in the support of the institution. The school owns 195 acres of land, 4 of which are available for athletics.

There is a gymnasium and a swimming pool. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, Frank M. Driggs.

Commission for the Blind. Created in 1909. Four thousand dollars was appropriated for the first two years. The activities of the Commission were similar to those indicated under "Commissions for the Blind" in the Introduction to this section. The Commission no longer exists.

Libraries for the Blind, Ogden, School for the Blind. Five hundred and fifty volumes; 400 titles. Books are circulated throughout the state.

Salt Lake City, Public Library. Auxiliary of the Reading Room for the Blind. One hundred and eighty-seven volumes. Books are circulated in Salt Lake City and community. A teacher is employed by the Auxiliary to teach at the library.

Society for the Aid of the Sightless, Provo. Organized in 1904. Helped to bring about the establishment of the Commission for the Blind. Since 1913, it publishes the "Messenger to the Sightless," a monthly magazine in Braille.

VERMONT.

The Austine Institution, Brattleboro. Incorporated, 1904; opened, 1912, as a result of the bequest of Col. William Austine, and of additional money appropriated by the state. The School receives a yearly per capita allowance for the board and tuition of each pupil designated by the state. All other expenses are paid by parents or guardians. For paying pupils, the fee is $400 per year for board and tuition. This school is intended for the education of wholly or partially deaf or blind children. At present there are five blind pupils. The school owns 212 acres of ground. Principal, Helen G. Throckmorton.

VIRGINIA.

School for the Deaf and Blind, Staunton. Founded, 1839. Capacity, 80. Valuation of plant, $200,000 (both departments). State appropriation, $16,800 for the present fiscal year (both departments). The school owns 96 acres of land, 4 of which are available for athletics. There is a gymnasium. Requirements for admission, course, term and purpose of instruction, see the Introduction to this section. Superintendent, Wm. A. Bowles.

School for the Colored Deaf and Blind, Newport News. Founded, 1906. Capacity, 150. Valuation of plant, $125,000. Annual state ap-

propriation, $25,000. The school owns 88 acres of land, 3 of which are available for athletics. Superintendent, Wm. C. Ritter.

Library for the Blind, Staunton, School for the Deaf and Blind. One thousand titles. Books are circulated throughout the state.

WASHINGTON.

School for the Blind, Vancouver. Founded, 1906. Capacity, 65. Valuation of plant, $110,000. Annual state appropriation, $61,000. The school owns 6 acres of land, three quarters of an acre being used for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, Mrs. W. B. Hall.

Seattle Association for the Blind. Secretary, M. Callaghan. Membership, 40.

Libraries for the Blind, Seattle, Public Library. Six hundred and thirty volumes; 376 titles. Books may be sent anywhere. A typewritten catalog available without charge.

Spokane, Public Library. Fifty-six volumes; 18 titles. Books may be circulated only in Spokane.

Vancouver, School for the Blind. Seven hundred and fifty volumes; 165 titles. Books may be circulated throughout the state.

WEST VIRGINIA.

School for the Deaf and the Blind, Romney. Founded, 1870. Capacity, 85 blind. Valuation of plant, $350,000. Annual state appropriation, $65,000 for current support (both departments). Ten thousand dollars for betterments. School owns 150 acres of land, 4 of which are used for athletics. There is a gymnasium in the basement of the school building. For requirements for admission, course, term and purpose of instruction, see the Introduction of this section. Superintendent, Parley De Berry.

Library for the Blind, Romney, School for the Blind. One thou sand, five hundred volumes. Books are circulated throughout the state.

WYOMING.

The education of blind youth is provided at state expense by sending pupils to schools for the blind in neighboring states.

WISCONSIN.

School for the Blind, Janesville. Founded, 1849. Capacity, 150. Valuation of plant, $300,000. Annual state appropriation, operation,

\$50,000; repairs and maintenance, \$10,000; new buildings, \$15,000. The school owns 65 acres of land, 5 of which are available for athletics. There is a gymnasium. For requirements for admission, course, term and purpose of instruction, see the Introduction to this section. Superintendent, J. T. Hooper.

Co-education of the Blind and the Seeing in the Public Schools of Milwaukee. Classes for blind children were opened in November, 1907. There are four centers for children in the various grades, and three high schools that admit pupils. The enrollment is 57. The youngest pupil, 5 years old, attends the kindergarten, and the oldest, 20 years, is studying in high school. For details of the public school method of educating the blind, see the Introduction to this section. Teacher in charge, Miss Carrie B. Levy.

Co-education of the Blind and the Seeing, in the Public Schools of Racine. One center was opened in February, 1909. Enrollment, 6. The youngest pupil is 12, and the oldest 14. Details of this method of instruction will be found in the Introduction to this section. Teacher in charge, Catherine M. Light.

Workshop for the Blind, Milwaukee. Established, 1903. Number of blind employees, 35. They occupy rented quarters. Annual state appropriation, \$8,455 for operation of the workshop, rent, power, light. salary of superintendent, and instructors; \$600 annually for purchase of machinery and equipment, furniture, furnishings, and other permanent improvements. Allowance for labor to blind workmen in 1915 was \$11,706.31, representing profit above the cost of material. All men are paid by piece work. Indigent blind are allowed the difference between their earnings and their board and lodging while learning a trade; the allowance not to exceed \$75.00 in any one case. Superintendent, Oscar Kustermann.

Pensions for the Blind. The sum of \$25.00 is paid quarterly to blind males over 21 and females over 18 years of age, and not inmates of any institution and having an income of less than \$250.00 per annum. Applicant must have been a resident of the state for 10 years and county three years. Payment of this relief is at the discretion of the County Board. The law has been in operation since 1907.

Wisconsin Association for the Blind. Incorporated, May, 1912. Its purpose is to "promote the interests of the blind and to secure sufficient legislation towards prevention of blindness." It is supported by membership fees. In addition to the charter members any person may become a member by paying the annual dues. Headquarters are located at the place of business of the secretary. Secretary, Carrie B. Levy, Board of Education, Milwaukee.

Libraries for the Blind. Janesville, School for the Blind. Six thousand two hundred and eighty-five volumes; 519 titles. The books are circulated throughout the United States.

Milwaukee, Public Library. Three hundred and fifty volumes; 254 titles. Books are circulated in Milwaukee.

CANADA.

NOVA SCOTIA.

Halifax School for the Blind. Founded, 1867. Opened, 1871. Capacity, 150. Valuation of plant, $160,000. Supported by annual Government grant of $5,000, and income from endowments. The grounds contain four acres, two of which are available for recreational purposes. There are two gymnasia.

This School is a monument to the ability and devotion of a blind man who has been superintendent of the institution since it was established. In addition to the usual industries referred to in the Introduction to this section the girls are given a course in shampooing. Aside from the fact that this fits each girl to take the best personal care of herself, it frequently happens that it becomes a source of income after she returns to her home. While it is doubtless a fact that many of the schools on this continent have admirable mottoes, our most northeasterly outpost has one that might well be hung in every school for the blind, and it should certainly be adopted by those who want to help the sightless. It is, "Opportunity, Occupation, Optimism." The superintendent, Sir Frederick Fraser, has won for himself such recognition in the community as a valuable citizen that he had the unique distinction of being called to the bar of the legislature and publicly thanked for his services. A similar event had not taken place in the province for 84 years. In June, 1915, this splendid leader of the blind was still further honored, having been knighted by King George. It is noteworthy that the only two men working for the benefit of the blind who have received such an honor at the hands of the British sovereign are both blind, and both have virtually created the schools over which they presided for 40 years. It is remarkable, also, that they began their respective schools within 12 months of each other. The first (to whom we have referred) is Sir Frederick Fraser, of the School in Halifax, and the other is Sir Francis Campbell, of the Royal Normal College for the Blind, London, England.

Home Teaching Society for the Blind. Headquarters at School for the Blind, Halifax, N. S.

Maritime Association for the Blind. Founded, 1908. The organi-

zation is maintained by subscriptions, and income from endowments. There is an annual fee of $1.00. It is the purpose of the organization to care for graduates and procure ready employment for them. Headquarters at Halifax School for the Blind. President, S. R. Hussey, School for the Blind, Halifax, N. S.

Libraries for the Blind. Halifax, Circulating Library for the Blind. Five hundred volumes, 350 titles. The books are circulated throughout Canada and Newfoundland.

QUEBEC.

School for the Blind, Sherbrook St., West., *Notre Dame de Grace.* Founded, 1912. Capacity, 40. Valuation of plant, $100,000. Supported by voluntary contributions. The school owns 10 acres of land, 5 of which are available for athletics. There is a gymnasium. For requirements for admission, course, terms, and purpose of instruction, see Introduction to this section. Director, P. E. Layton.

Montreal Association for the Blind. Founded, 1908. Supported by voluntary contributions. A broom shop, giving employment to 14 men, is operated. Valuation of broom shop building, $35,000. The Association for the Blind is entirely responsible for the raising of funds and founding of the school for the blind. At the present time the school for the blind youth and the workshop are located on the same lot of land. The president of the association is Lt. Col. E. B. Busteed. Honorary Treasurer, Philip E. Layton; Honorary Secretary, Mrs. Philip E. Layton.

The Nazareth Asylum, 95 St. Catherine St., W., *Montreal.* A French Catholic institution. A school and home. One hundred French blind in the institution. Supported by a government grant and private funds.

The Mackay Institute for the Deaf and the Blind, 221 Boulevard De Carie, *Montreal.* Began taking pupils in 1876. This is a protestant institution for English-speaking deaf and blind. Supported by a government grant and private subscriptions. At present there are only six blind children at the Mackay Institute.

Libraries for the Blind. Montreal, School for the Blind. Six hundred volumes. Books loaned to the blind of the province of Quebec.

ONTARIO.

School for the Blind, Brantford. Founded, 1872. Capacity, 150. Valuation of plant, $400,000. Annual cost to Provincial Government, $47,749.66. The school grounds comprise 104 acres, of which about half is cultivated, the remainder being lawn and shrubbery. Ten

acres are available for athletics. There is a gymnasium. For requirements for admission, course, term, and purpose of instruction, see the Introduction to this section. Superintendent, H. F. Gardiner.

Libraries for the Blind. Brantford, School for the Blind. Two thousand volumes for circulation among the blind throughout the province. The books used in the Ontario public schools are printed in New York Point at the Brantford School for the use of the pupils, also hymn and song books and music for piano and organ. It is very interesting to note that Superintendent Gardiner has worked out a practical set of instructions to enable relatives or friends (without preliminary study, training, or instruction) to teach the blind at their homes to read New York Point. The sheets are printed in ink-print and in New York Point, and Mr. Gardiner is pleased to supply applicants without charge no matter in what country they may live. The system is particularly useful to men and women who lose their sight when too old to attend school.

Library for the Blind. Toronto, Canadian Free Library for the Blind. Four thousand two hundred and fifty-seven volumes; 1280 titles; 1500 musical selections. Books are circulated free throughout Canada, and loaned occasionally to readers in the United States. The library is supported partly by grants from several provincial governments but mainly by private contributions.

NATIONAL WORK FOR THE BLIND IN THE UNITED STATES.

American Association of Instructors of the Blind. On August 16, 1853, delegates from fourteen different institutions, representing as many states, met in accordance with previous arrangements at the New York Institution, and effected the organization of the body which has since been so potent a factor in advancing the interests of the blind. This was a notable event. It was the first meeting of the kind ever held on the American continent. It was presided over by Dr. Samuel G. Howe. The immediate object of this meeting was to discuss the propriety of petitioning Congress to grant a subsidy for a permanent printing fund for the use of the blind, and although other questions were considered, they seem of small importance in comparison with this. The agitation on this subject begun then did not cease until March, 1879, when an act was passed by the Congress of the United States setting apart, as a perpetual fund, $250,000, the interest of which is annually used in providing books and apparatus suitable for instructing the blind. This result alone justifies the existence of the association. Consider for a moment, what was involved therein. It was the first recognition

by the general government that the blind had any rights which deserved its respect. It had made provision by grants of land to further the education of seeing children, it had aided the deaf and dumb, it had considered the Indian and the Negro, and it had not refused to allow the alien participation in these privileges; but until this act passed the children who live in continuous night had been neglected and ignored. It was a triumph of human rights, and it germinated in the first meeting of the association.

The second convention was not held until August, 1871. It met at the Indiana Institution in Indianapolis, pursuant to a circular issued by W. H. Churchman, superintendent, in which the immediate object of the meeting was declared to be the adoption of a *uniform system of printing for the blind.* This convention approved the books printed in the modified Roman lower case type, known as the Boston letter, and also those printed in the combined system of the capital and angular lower case letter. At the same time it was resolved that the New York horizontal point alphabet, as arranged by Mr. Wait, should be taught in all institutions for the blind. This was the beginning of the agitation with reference to point print. There were also discussions on the capacity of the blind to engage in commercial and domestic pursuits, concerning the teaching of more manual arts in the schools, with reference to the education of the deaf and dumb and the blind in the same institution, and regarding musical education, besides other minor questions.

Since 1871 the American Association of Instructors of the Blind have met nearly every other year at various institutions throughout the country. When the United States Government set aside funds for the production of books for the education of blind children, the superintendents of schools were practically made an advisory committee of the American Printing House for the Blind, and this fact gave a real reason for the actual coming together of the superintendents. While the type question has been a fertile source of discussion from the very foundation of this organization, helpful papers have been presented upon all phases of work for and by the blind. Secretary, George D. Eaton, superintendent, School for the Blind, Vinton, Iowa.

AMERICAN ASSOCIATION OF WORKERS FOR THE BLIND.

In the spring of 1895 some graduates of the Missouri School for the Blind sent invitations to a number of persons believed to be interested in securing permanent provision for the higher education of the blind, and a meeting was held in St. Louis in September of that year which resulted in an organization entitled the Missouri National

College Association, the purpose of which was to secure from the Federal Government an appropriation to establish a college for the blind. The second convention was held in 1896, again in St. Louis, and the special college idea was found to be unpopular and was abandoned. The local organization was then placed upon a national basis, and the name changed to The American Blind Peoples' Higher Education and General Improvement Association.

Other meetings were held from year to year and gradually this organization interested itself in all phases of work for the blind. At the eighth convention, which met at the Michigan Employment Institution for the Blind in 1905, a revised constitution was adopted and the name changed to The American Association of Workers for the Blind and, by receiving most of the workers present into membership, one of the ideals of the early promoters was realized—a perfect union of the blind and those actively engaged in work for the blind. From that time to the present meetings of this Association have been held during the odd years so that there would be no conflict with the meetings of the A. A. I. B. which holds its meetings during the even years. The A. A. W. B., like that of the older organization, soon became interested in the difficult type question and appointed a committee of blind men and women which has been known as the "Uniform Type Committee" which has worked for ten years upon this complicated subject.

The A. A. W. B., like the A. A. I. B., has held discussions relative to all phases of work for the blind. The only difference between the two organizations is that the older association confines its membership to those concerned with the *education* of blind youth, while the A. A. W. B. includes not only these but all others who are interested in *any work* for the blind. It may be said that the greatest work accomplished by the younger society is that it has brought about a better understanding between the blind and all workers for the blind. Secretary, Charles F. F. Campbell, superintendent, School for the Blind, Columbus, Ohio.

UNIFORM TYPE COMMISSION

In 1915 the A. A. I. B. and the A. A. W. B. (just referred to) held their conferences in California. The final report of the *Uniform Type Committee*, of the A. A. W. B., was presented and accepted. This report recommended, among other things, the establishment of a Uniform Type *Commission* which should represent both organizations and have the power to confer with a similar commission in England. This Commission was composed of a representative from each organiza-

tion and a third chosen by these two, together with the presidents of both organizations as members ex-officio and one honorary member. This Commission presented its report at the 1916 convention of the American Association of Instructors of the Blind and the following resolutions were adopted:

First—That the American Association of Instructors of the Blind in convention assembled adopt officially and urge upon the blind of America and those interested in the work for the blind to adopt individually and officially "Revised Braille," Grades I and II, as now authorized in Great Britain, Provided however, that the duly authorized English Committee on Uniform Type come to a full agreement with our American Commission on Uniform Type for the Blind concerning such modifications in "Revised Braille" as have been proposed by the American Commission or as may be proposed by either the American Commission on Uniform Type or the English Committee on Uniform Type.

Second—That the Commission on Uniform Type be continued and that it be expanded to include representatives of residential schools, public schools having classes for the blind, home teachers, embossed printing presses and libraries for the blind, these representatives to be named by the President of the American Association of Instructors of the Blind after due consultation with the President of the American Association of Workers for the Blind. Executive Secretary, H. Randolph Latimer, 2223 North Charles Street, Baltimore, Md.

AMERICAN PRINTING HOUSE FOR THE BLIND, LOUISVILLE, KY.

Established, 1858, by an act of the general assembly of Kentucky. At first, its resources were derived from a concession of the state of Kentucky of $5.00 a year for each blind person in the state. In 1879 the U. S. Government set aside a fund providing an annual subsidy for this National printing house of $10,000. The books produced from this national grant are divided upon a per capita basis to all of the schools throughout the country. In 1883 a fund of $40,000 had accumulated from the state of Kentucky with which a building was erected. Unfortunately the national subsidy has not been increased to keep pace with the increase in the blind population of the country, and, at the present time, a much larger fund could profitably be used. Superintendent, B. B. Huntoon. See, also, **Alphabets and literature for the blind.**

THE LIBRARY OF CONGRESS, READING ROOM FOR THE BLIND.

In 1897 there was opened in the Library of Congress a "Room for the Blind." This room serves as a repository for books used by the

blind and for a collection of the apparatus employed by the blind to gain an education, and many articles made by the blind. The blind of the District of Columbia come to this room not only to secure books but also to attend occasional entertainments given for their benefit by artists who are visiting or living in Washington. One of the most valuable features of this room is that it brings to the attention of thousands of sightseers, who annually pass through Washington, the knowledge that good work is being done for the blind throughout the country. It frequently happens that a visitor from a distance has derived his first impulse to help in work for the blind of his home state because of the things he saw made for and by the blind at the Library of Congress.

There are today about 4,000 volumes in all the various systems of types available at the library. So far as its collection permits, books are loaned to those outside of the District of Columbia if borrowers are unable to secure the books they desire in their own locality or in a neighboring state. An ink-print catalog will be sent free upon application. Librarian-in-charge, Mrs. Gertrude T. Rider.

NATIONAL LIBRARY FOR THE BLIND, 1729 H ST., N. W., WASHINGTON, D. C.

Founded, 1913. Supported by voluntary contributions. As the name implies, this institution is a library, though an effort is being made to produce books and to a limited extent this is being done as a result of blind labor. Books are published in English Braille. There are 1074 volumes and 511 titles available. Books may be circulated throughout the United States. Ink-print catalogs are furnished free and the same in English Braille are sold for ten cents each. Librarian, Miss Etta Josslyn Giffen.

AMERICAN LIBRARY ASSOCIATION—COMMITTEE ON WORK WITH THE BLIND.

Appointed to report progress in library facilities for the blind and recommend advance. Chairman, Mrs. Gertrude T. Rider, Library of Congress, Washington, D. C.

AMERICAN MEDICAL ASSOCIATION—SUB-COMMITTEE ON CONSERVATION OF VISION OF COMMITTEE ON HEALTH AND PUBLIC EDUCATION.

Organized, 1907. Publishes pamphlets by members of the medical profession on conservation of vision, conducts lecture campaigns and promotes legislation. Chairman, Dr. Frank Allport, 7 Madison Ave., Chicago, Ill.

NATIONAL COMMITTEE FOR THE PREVENTION OF BLINDNESS, 130 EAST 22ND STREET, NEW YORK CITY.

Established, January 1, 1915. Supported by voluntary contributions. This committee is the result of the merger of the American Association of Conservation of Vision with the New York State Committee for the Prevention of Blindness. It carries on active propoganda for prevention of blindness and conservation of vision, its purposes being:

1. To endeavor to ascertain, through study and investigation, any causes, direct or indirect, which may result in blindness or impaired vision. 2. To advocate measures which shall lead to the elimination of such causes. 3. To disseminate knowledge concerning all matters pertaining to the care and use of the eyes. At the present time the Committee publishes a *News Letter* giving information of the movement; maintains a loan collection of lantern slides for illustrated lectures; provides lecturers, and publishes literature on the several subjects connected with its work. Managing Director, Edward M. Van Cleve.

THE SOCIETY FOR PROVIDING EVANGELICAL RELIGIOUS LITERATURE FOR THE BLIND, 39 WEST 32ND STREET, NEW YORK, N. Y.

Incorporated, 1879. To provide religious literature in embossed form for the blind. Supported by voluntary contributions. Provides the International Sunday School Lessons and non-denominational literature for the blind boys and girls, teachers and pastors. President, Rev. Robert Johnston, D. D., Philadelphia, Pa.; Treasurer, William B. Wait, 133 West 92nd Street, New York.

XAVIER FREE PUBLICATION SOCIETY FOR THE BLIND, 59 EAST 83RD STREET, NEW YORK CITY.

Incorporated, 1904. Disseminates Catholic literature among the blind of the United States, and furnishes to all libraries for the blind, copies of its publications in New York Point and in Braille. Publishes also the *Catholic Transcript for the Blind,* in New York Point, and the *Catholic Review for the Blind,* in Braille—both monthly magazines. Director, Rev. Joseph M. Stadelman, S. J.

PERIODICALS FOR THE BLIND AND THEIR FRIENDS.

American Braille.

Canada's Premier Magazine; for the circulation throughout the Dominion, published by the Dominion Tactile Press, 275 Delaware Ave., Toronto, Canada.

Catholic Review; monthly, published by the Xavier Free Publication Society for the Blind, 824 Oakdale Ave., Chicago, Ill.

Christian Record; monthly, published free by the Christian Record Publishing Co., College View, Nebraska.

Church Items; monthly, except July and August, published by Miss S. B. Herreshoff, Bristol, R. I.

Gospel Trumpet; monthly, published by the Gospel Trumpet Co., Anderson, Ind.; transcribed from the ink-print. Subscription price, $1.50.

Illuminator; quarterly, published free by the Holmes-Schenley Literary Society of the Pittsburgh School for the Blind, Pittsburgh, Pa.

Matilda Ziegler Magazine for the Blind; monthly, published free by The Ziegler Publishing Co., 250 West 54th St., New York City. Walter G. Holmes, President and Manager.

This magazine is published monthly in raised type for the blind by the Matilda Ziegler Publishing Company. It is printed in both New York Point and American Braille and is sent free to the blind of the United States and Canada. It contains current news items and fiction. The magazine was founded in 1907 by Mrs. Matilda Ziegler, of New York, who maintains it at a cost of over $20,000 a year. During this century no single effort in behalf of the blind has brought so much happiness to those who spend their lives in darkness. See, also, **Alphabets and literature for the blind.**

Michigan Herald; monthly, except July and August, published by the Michigan School for the Blind, Lansing, Mich. Subscription price, 25 cents.

Music Survey; monthly, published by the Novel Music Embossing Co., Jacksonville, Ill. Subscription price, $2.00.

Searchlight; published free by the New York Association for the Blind, 111 East 59th St., New York City.

Weekly News; weekly, published by the Novel Music Embossing Co., Jacksonville, Ill. Subscription price, $3.00.

World of the Blind; monthly, published by the United Workers for the Blind of Missouri, 2616 Gamble St., St. Louis, Mo. Subscription price, $1.00.

New York Point.

Catholic Transcript; monthly, published by the Xavier Free Publication Society, 59 E. 83rd St., New York City.

Christian Record; monthly, published free by the Christian Record Publishing Co., College View, Nebraska.

Free Press; monthly, Janesville, Wis.

Lux Vera; monthly, published by Joseph Gockel, 834 36th St., Milwaukee, Wis. Subscription price, $1.50.

Matilda Ziegler Magazine for the Blind; monthly, published free by the Ziegler Publishing Co., 250 West 54th St., New York City. (See item under American Braille.)

Music Survey; monthly, published by the Novel Music Embossing Co., Jacksonville, Ill. Subscription price, $2.00.

Sunday School Quarterly; published by the Society for Providing Evangelical Religious Literature for the Blind, 39 West 32nd St., New York City. Subscription price, $1.00.

Weekly News; weekly, published by the Novel Music Embossing Co., Jacksonville, Ill. Subscription price, $3.00.

Weekly Review; weekly, published by Joseph Gockel, 834 36th St., Milwaukee, Wis. Subscription price, $2.50.

Ink Print.

The Cincinnati Globe; weekly, published by Frank Maciewski, 414 Greenwood Bldg., Cincinnati, O. Subscription price, $1.00.

Outlook for the Blind; quarterly, published in Columbus, Ohio; edited by Mr. and Mrs. Charles F. F. Campbell. Subscription price, $1.00 a year. Founded in 1907 by Charles F. F. Campbell, with the support of the Massachusetts Association for the Blind. Later, the American Association of Workers for the Blind and the American Association of Instructors of the Blind made the magazine their official publication, and each association appoints two representatives on the editorial staff, but they do not finance the periodical. There is an advisory board made up of representatives from practically every organization working in the interests of the blind in America. A complete file of this publication from 1907 to date gives latest information about work for the blind throughout the English-speaking world. Address: ''Outlook for the Blind,'' Columbus, Ohio.

Voices from Darkland; quarterly, published by the Columbus Polytechnic Institute for the Blind, Washington, D. C. Subscription price, 50 cents.

World of the Blind; monthly, published by the United Workers for the Blind of Missouri, 2616 Gamble St., St. Louis, Mo. Subscription price, $1.00.

Many schools for the deaf carry on printing departments and publish school papers. When a school for the blind is a part of a joint institution for the blind and the deaf, items of information about the work of the blind in these school periodicals are printed. We do not give a list of these school newspapers as they confine themselves almost exclusively to local matters.—(C. F. F. C.)

Instruction for the blind. See **Institutions for the blind.**

Instruction in ophthalmology. See **Pedagogy, Ophthalmic.**

Instrumental delivery, Ocular injuries from. See **Birth injuries.**

Instruments, Ophthalmic. Instead of arranging a section devoted to *all* the instrumental devices employed in eye surgery, individual captions are given, and to these the reader is referred; for example, **Fixation instruments**; **Cilia forceps**; **Bistouries**; **Forceps**; **Hooks**; **Specula**, as well as to such operation headings as **Cataract**; **Entropion**, etc.

Of course, it is impossible to make even a list of, much less to picture and describe, all the instruments (with their innumerable modifications) that have in modern times been employed in ophthalmic operations. However, it is the purpose of this *Encyclopedia* to classify and, so far as possible, mention the chief surgical appliances that are now used by the various schools of ophthalmic surgery in this and other countries.

It may at the outset be claimed that the simpler an instrument the greater value it has. The truth of this axiom is evidenced by the fact that only instruments of simple construction survive; complicated devices are generally consigned to the limbo of forgotten things shortly after their invention, if for no other reason than that the difficulties of asepsis, drying, polishing and repairing and, perhaps, sharpening, are so great that it is very difficult to use them for any length of time. Possibly another reason is that the inventions and discoveries of the embryo operator generally run towards complicated apparatus; it is rarely that the young surgeon invents a simple instrument. For this reason, if for no other, slight variations from well known models seem hardly worth mentioning even in a complete treatise on the subject; hence, there have been purposely omitted references to a large number of devices that are but slender variants of some previously invented instruments.

Landolt (*Br. Med. Journ.*, Nov. 2, 1907) whose writings on the subject form a classical introduction to the study of ophthalmic instrumentation, remarks that in order to attain to the requisite lightness and delicacy of handling, we must bring our finger tips as close as possible to that portion of the instrument which is to perform the actual work—let us call it the "active part" of the instrument—because the tips of the fingers possess the most accurate tactile sensation.

The requisite movement should be obtained from the finger-joints and not from the wrist, and even less from the arm. These two essentials will be obvious if we consider the execution of an exact drawing of small dimensions.

To obtain the requisite lightness and delicacy of touch we must use

the minimum of muscular effort in working with our instruments. A heavy or slippery handle, a forceps with a too resistant spring, etc., require a force which naturally detracts from the fineness of the execution.

Landolt recognizes in all surgical instruments three portions—the handle, the active extremity and the intervening part, or, shaft.

It seems almost as difficult to classify as it is to enumerate the large variety of small appliances employed in eye surgery. Although it may with justice be said that even the best classification is none too good, one cannot avoid the conclusions of Landolt that the handle is the most important of all the parts common to ophthalmic instruments, and a rational classification might be based upon the variations in that essential part of eye instruments. "It seems," says Landolt, "sometimes that the importance of the handle of instruments for our delicate operations has not been sufficiently appreciated. We may consider it from the point of material, form, dimensions, weight and surface. The handles of the instruments were formerly all of ivory.

Ivory is an ideal material for this use; it is not too heavy or too light, it is a poor conductor of heat, but its best quality is the character of its surface—it is not slippery, and yet adheres delicately to the fingers. We are thus able to manipulate the instrument with accuracy and lightness as well as security.

But we have been educated in the science of asepsis, and the sterility of our instruments must be our first consideration. There is no doubt that the ivory handles, as the makers give them to us, do not bear well the high temperature required for sterilization. But in reality it is less the ivory, than the cement and resin which are used in fastening the blade to the handle, that give way under high temperature. The resin melts and the blade soon hangs loosely in the handle. If, however, we can discover a cement which is not spoiled by heat, or if the maker will take the trouble to fasten the blade with a screw in a metal matrix made secure in the handle, this invaluable material may still be made use of. Although ivory cracks and is spoiled after repeated exposure to 140 degrees C., it is able to stand several sterilizations, and the handle can then be changed, as ivory is not an expensive material.

Instead of trying to save ivory for us, the makers of instruments have substituted for it iron, steel, and aluminum. The general surgeon has accepted this change without a murmur. Of course, when the instrument is held by the whole hand, the material makes little difference, but with us, who must manipulate our instruments with lightness, the weight and surface of the handle is of capital importance.

The handles of steel and iron are too heavy for our work, even the

hollow ones as they are furnished; their weight and slippery surface makes us grip them with so much muscular effort that the delicacy of our manipulation suffers. The rough surfaces, although they are to be preferred to smooth ground surfaces, are not satisfactory. The ideal material is still ivory, and the only thing which approaches it is aluminum.

Aluminum has another quality in which it approaches ivory, that is, lightness; it is superior to ivory in the ease with which its stands dry sterilization. Aluminum, however, at least that which our instrument makers use, is not always pure and is spoiled by certain antiseptic solutions; but this is of no importance, as dry heat sterilization is to be preferred to boiling, and simple sterilized saline solution to so-called antiseptic solutions during the operation.

There is little or nothing to say against the form of the handles supplied to us by the best makers. The handle thickens a little in its third part nearest the blade, a section of it showing a rectangle with bevelled edges. The surface of the cataract knife blade, as is the iridectomy knife blade, is parallel to the broad side of this rectangle. This is quite correct. Though we hold these instruments in a different fashion, one must always have the tip of the thumb on one side of the broad surfaces and the tips of the first and middle fingers on the opposing broad surface of the handle, so as to prevent its rotating on its axis without the operator's wish. If, on the other hand, he desires to rotate the instrument slightly, he must be able to do so easily; this the bevelled edges permit. The corners must therefore not be sharp but rounded somewhat, so that the movements can be made slowly and precisely.

It sometimes happens that the blades of curettes and vectes are placed perpendicularly to the broad side of the handle, instead of being parallel to it. This is an unpardonable fault.

It is natural that instruments which are rotated around their axes while in use should have a handle a section of which is square, with rounded rather than bevelled edges.

Acting, then, upon the hint given by Landolt, ophthalmic instruments may be divided into the following categories: (a), instruments with straight, slender handles; (b), instruments with large or crooked handles; (c), instruments with double or special handles; (d), instruments and appliances without handles.

A.—Ophthalmic instruments with straight and slender handles. This class includes knives of various descriptions, scalpels, bistouries, all sorts of cataract and lachrymal knives, keratomes, cystotomes, knife-needles, tattooing needles and other needles mounted on handles, hooks,

spuds, retractors, loops, spoons, repositors, sounds, canaliculus and lacrimal duct dilators, etc. These instruments are described and pictured under their individual headings.

If it were possible it would be of great advantage to the oculist if the straight handles of all the instruments just mentioned, could be made of the same length. Landolt particularly draws attention to the extreme length of the handles of some instruments. When it is remembered that the manipulation of these instruments should be carried on almost entirely with the fingers, as mentioned above, it will readily be seen that there is no sense in having them as long as they are usually made. For example, Landolt draws attention to the difference in this respect between the shaft of the Lüer model of Taylor's scoop and the Pagenstecher spoon. He remarks their extreme length and asks "How is it possible to execute satisfactorily with such instruments those most difficult of eye operations, the extraction of a dislocated lens, or of a lens in its capsule? It removes the operator's fingers to too great a distance from the patient's eye, and also from the active end. In order to remedy this inconvenience, one is tempted to hold the instrument by the shaft only, and run the risk of its thin, round shaft revolving in the grasp, and further of destroying the proper balance of the instrument. The same is true of cystotomes, curettes, and spatulæ—in fact, of all the instruments which we introduce into the globe. Let us curtail the shaft of all these instruments to its proper length."

B.—Ophthalmic instruments with large or crooked handles. This classification is intended to include trocars, chisels, saws, trephines, punches, curettes, spatulæ, tissue-hooks, applicators. See the captions appropriate to each of these.

It will be noticed that these instruments are common to ophthalmic and general practice, and beyond stating that when employed for eye operations they should be somewhat smaller and more slender than those employed by the general surgeon, it is not necessary either to give an extended description of them or to illustrate the text by cuts. Moreover, when it has been necessary to refer to any special instrument in this class it will be found under the appropriate heading.

C.—Ophthalmic instruments with double or special handles. This class includes various forceps, scissors, needle-holders, lid-clamps, forceps-scissors, scissors-handled punches, scissors-handled forceps, chalazion forceps, pincers, etc. See the individual headings.

Most of these instruments may be divided into subclasses as, for example, three or four variations of forceps (iris, fixation, cilia, special lid).

One of the difficulties of classification arises from the variety of names and terms given in different countries to the same (or practically the same) instrument. This difficulty is all the more marked when in the same country identical devices are attributed to different sources and furnished with different designations, or at least different catalogue names. As an example of this last named error the figure of A. E. Ewing's *Entropium forceps* is on page 4337, Vol. VI of the *Encyclopedia* accredited to Dr. Post.

W. C. Rockliffe (*Ophthal. Review,* p. 191, July, 1909) warns operators of a certain danger from improperly nickeled instruments and reports a case of senile cataract extraction during which a piece of plating 1x1.5 mm. became detached from the iridectomy scissors, found its way into the anterior chamber and led to the loss of the eye operated on.

Insufficiency of convergence. See p. 97, Vol. I, as well as p. 4788, Vol. VI, of this *Encyclopedia,* and under **Muscles, Ocular.**

Insufficiency of divergence. See pp. 4051 and 4523, Vol. VI, of this *Encyclopedia.* Also, see under **Muscles, Ocular.**

Insufficiency of the obliques. See **Cyclophoria.**

Insufficiency of the ocular muscles. See **Heterophoria.**

Insufficientisme. (F.) The doctrine of expectant treatment that regards therapeutical means as insufficient.

Insufficienz der Rollung. (G.) Cyclophoria.

Insuffisance des muscles droits. (F.) Heterophoria.

Insultus. (L.) An attack, onset, or paroxysm, as of a disease.

Insurance in eye injuries. See **Visual economics,** and **Injuries of the eye,** as well as **Legal relations of ophthalmology.**

Intensation. Elevation to a higher degree of intensity.

Intensification. In photography, the increasing of the printing density of a negative.

Intention. The process by which the lips of a wound unite in the healing of the wound; e. g., *by first intention,* union of the parts without the formation of pus or of much cicatricial tissue.

Interaction. Mutual or reciprocal action.

Interaxial. Situated between axes.

Intercalar. Situated between the sclero-corneal margin and the ciliary body, e. g., an *intercalar staphyloma.*

Intercilium. (L.) The protuberant (but occasionally depressed) surface between the two superciliary ridges.

Intercutaneomucous. Occurring or situated between the skin and mucous membrane.

Interference. In *physics*, the mutual action of waves of any kind (whether those in water, or sound-, heat-, or light-waves) upon one another, by which, under certain conditions, the vibrations and their effects are increased, diminished, or neutralized. The term was first used by Young to express certain phenomena which result from the mutual action of the rays of light on one another. In general, if two systems of waves come together, they *interfere*—that is, they unite to reinforce or destroy one another, the actual disturbance of the medium at any instant being the resultant of the two disturbances considered separately. For example, if the two systems are of equal intensity and in the same phase, the result will be a doubled disturbance; if, however, they are half a wave-length apart, the result will be rest. Thus, two sounds of the same pitch and intensity produce a note of double the intensity when they meet in the same phase, the point of condensation of one corresponding to that of the other; when, on the other hand, the point of maximum condensation of the first corresponds to that of rarefaction of the other, they destroy each other. Again, if two notes differing but slightly in pitch (say one vibration per second) are sounded together, there will be one instant in each second when the two wave-systems will nearly coincide in phase, and one when they will be half a wave-length apart; the result is that they alternately strengthen and weaken each other at these moments, and the ear perceives the pulsations in the note called beats. The same principles hold true in the case of light, as was first shown by Young. The interference of light-waves is illustrated by the phenomena of *diffraction* (q. v.). Thus, a *diffraction grating* (q. v.) gives with *monochromatic light* (q. v.) a series of light and dark bands (interference fringes (q. v.)), corresponding respectively to the points of maximum and minimum rotation resulting from the mutual action of the two wave-systems; for the former, they are in the same phase, for the latter they differ in phase by half a wave-length. If white light is employed, a series of spectra (interference spectra) of different orders is obtained. Newton's rings, obtained for example, when ordinary light is reflected from a convex lens of long focus pressed upon a plate of glass, are circular interference spectra. The colors of thin films, as of oil on water or of a soap-bubble, are due to interference, as is also the iridescence of some antique glass or mother-of-pearl. Still again the beautiful figures produced when a section of a uniaxial crystal cut normal to the axis, or of a biaxial crystal cut normal to the bisectrix is viewed in converging polarized light are similar phenomena, and are hence called interference figures. In 1888, Hertz demonstrated that electric waves, produced, for example, by induction discharges between

two metal surfaces and propagated through space, also exhibit, under proper conditions, interference phenomena. These waves may have a length of several feet.—(C. F. P.)

Interference bands. INTERFERENCE FRINGES. In *physics*, the dark bands produced by the interference of light waves whose periods of vibration are equal, and whose phases at the source are the same or differ by an amount that remains a constant. The dark bands are the fringes of the adjacent bright bands whose brilliant illumination is due to superposition of the light waves. On the whole there is no annihilation of the light, but only a redistribution of it, accounted for by the bright bands drawing from the illumination of the fringe-areas so as to produce excessive brilliancy of the former.—(C. F. P.)

Interference refractometer. An instrument making use of interference phenomena for measuring very minute magnitudes.

Interferometer. INTERFEREOMETER. This term is used to denote any arrangement which separates a beam of light into two parts and allows them to reunite under conditions to produce interference. Thus the utilization of the two portions of a lens, at opposite ends of a diameter, converts the telescope or microscope into an interferometer. The use of the term interferometer is for convenience, however, restricted to instruments in which the division and the union of the pencils of light are effected by a transparent plane parallel plate, as in the interferometers of Michelson and Janin.

Among the applications of the interferometer may be mentioned: Measurement of the length of light waves; measurement of the index of refraction; the coefficient of expansion; the coefficient of elasticity; the testing of precision screws; etc.

Interfrontal. Between the halves of the frontal bone.

Interimprothesis. A glass eye, made after Snellen's ''reform'' eye, but with a hole in the middle in the place of the pseudocornea, is described by Gallemaerts (*Tydschr. van Gen.*, October, 1906). This device is placed in the conjunctival sac very soon after enucleation, for the purpose of providing drainage of the sac. He puts it in the first or second day after operation, or directly after the operation. It also prevents loss of elasticity of the eyelids, is not disagreeable, and the patient can appear in public sooner.

Interior decoration. Otto Wipper (*Ophthalmic Record*, April, 1914) discusses this subject from the standpoint of the ophthalmologist.

He believes that perfect harmony of colors and lines in our rooms will have a soothing and healthful influence upon the eye, the mind, and the nervous system in general. Symptoms like headache, vertigo, and others which are frequently allied with eye affections, will in

many cases be greatly relieved after the aspect of a room has been changed from a disturbing one to one that is harmonious.

When looking at objects six meters away, or farther, we say that the adjusting power for various distances of the normal eye is relaxed, but ordinarily we have all indoor objects nearer than six meters, so we can readily see that within the house the normal eye is very little at rest, and the far-sighted much less so.

There is nothing more pleasing and soothing to the eye and mind than a really pretty landscape with ample perspective; this is especially true in the fall of the year, when the sun is less intense and a marked confusion of colors has taken place. All contours and the abundance of rich colors are then softly glazed to an iridescent atmosphere. Wherever the point of sight is chosen, or, in other words, whether one looks at the different parts directly, as the sky, foliage, field, water, or one takes in the picture as a whole, the influence is inspiring and restful.

Now, in interior decorating we should aim to bring this iridescent atmosphere into the general aspect of rooms, which can be accomplished to a certain extent without any too realistic representation of natural objects. It would not do to have all surfaces covered with true reproductions of outdoor scenes; this might be beneficial to the eye directly, but it would also cause a psychological disturbance in carrying one's mind away from home, from the place intended to be made beautiful and comfortable in itself.

In decorative art, natural objects are modified; this applies to color as well as to form. Outdoor scenes should be conventional, at least in color. Also the floral decorations, no matter how true the representation, should be conventional at least in their arrangement. Ornaments are composed by choosing natural objects as motives, which, with a certain amount of freedom and fancy, are combined and modified to create beautiful effects.

To obtain satisfactory results, the interior has to be considered in its entirety: First, the purpose for which a room is to be used, next the architecture, then the furnishings, and finally the covering of surfaces and ornamental decorations. Every detail and feature should be in harmony with the rest of the room, and the whole effect should be pleasing and agreeable, and at the same time the eye relieved from the strain that accompanies too much near fixation. Certain eye affections need special attention to make a room suit the individual case.

It is needless to say that as regards the health in general, the sanitary finish is an important factor. Sickrooms, baths, closets, and kitchens should be supplied with such finish, but when it comes to the so-

called living-rooms (whatever names they are given), and quite often bedrooms as well, it is rather difficult to interest people in decorative schemes which are strictly sanitary in every respect; although, if the house is kept reasonably clean, the good influence which artistic wall coverings, draperies, rugs, ornaments, etc., have upon the eye and mind will amply compensate their insanitary qualities as dust and germ catchers. The goal of all endeavor is happiness, and artistic decorations certainly contribute a great deal to the accomplishment of that end, but of course it requires study and some artistic feeling to direct and execute them properly.

Physiology divides the function of the eye into three faculties: Form-sense, light-sense, and color-sense; all three are essential to good vision.

To be pleasing and beneficial to the form-sense, the shape and lines must be well designed and in proper proportion to one another; they should be graceful and also give an object sufficient character so that it conveys the impression of having a purpose. Take, for instance, a chair: Whether plain or elaborate, the lines should be neat and its construction such as to give the impression that it is fit to sit upon. Sharp corners must be avoided, and when decorated with carvings, the latter are to be kept in a rather flat relief, without any sharp, projecting points, otherwise the chair is apt to be very uncomfortable. All furniture should have the same general lines and be in harmony with the architecture of the room itself. Whether a room is kept neutral or in a period, or in a so-called modified period, identical lines should prevail.

Nothing in the line of decorating is so frequently abused as the ornamental design; not only that the design itself is often poor, but it is also brought out too strong in color and applied too promiscuously; sometimes one sees one surface adjoining another covered with ornaments, having taken into consideration neither the architecture of the room nor the furnishings. Again we find some rather unesthetic motives in ornamental designs; for instance the unsightly masks and the grotesque animal heads; they may be appropriate in other places, but should be avoided in living rooms. Another objectionable article is sometimes found in the ornamental clock of the type where the poor little cupid or some other figure is making an effort to look pleasant, while carrying that comparatively heavy time-piece; rather a pitiful sight. Then we have the rugs, which afford a great deal of comfort, provided they are good in design and color; otherwise they may have quite a disturbing influence, especially when the flowers and ornaments are brought out so gaudy and plastic as if they were

to represent cast iron, causing one to be careful in stepping lest one stumble.

About the light-sense, much need not be said as regards interior decorating; the subject is fairly well covered in the paragraphs of form- and color-sense. Both light and shade are essential to our well-being. Plenty of sunlight is absolutely necessary in the house; it is conducive to cleanliness and hygiene; this applies in particular to chambers, baths, and sick-rooms. But on the other hand, the eye must be protected from too much light; the actinic rays especially are held to be destructive. The rays of the sun and artificial light are harmful when striking the eye directly; so are the powerfully reflected rays from bright surfaces, like those of snow, water, the light-gray sidewalks and also the very light surfaces of interiors. Finishes with a high gloss are very irritable and should be avoided. For reading, writing, and other near work, the source of light should be behind, slightly above, and to the left.

The power of the eye which enables us to distinguish light of different wave-lengths is termed the color-sense. In addition to enabling us to recognize objects, suitable color combinations contribute greatly to the enjoyment of life. Well developed color-sense is a necessary requisite to become a successful decorator; this of course refers to surface colors only.

We speak of light, dark, and medium colors, which expresses the same as light and shade. As to their intensity, colors may be bright, pale, rich, dull, deep, neutral, etc. Figuratively, the terms warm and cold colors are used a great deal in art, according to the impression which they convey, yellow and red being warm, white and blue cold, colors. On mixing, intermediate shades are obtained which may be either warm or cold; so we have warm and cold shades of gray, of blue, or any other color; on the other hand, a color may be neutral; for instance, a brown which is neither a yellowish, nor reddish, nor greenish-brown, could be considered neutral. When colors are harmoniously blended, we term the effect iridescent.

All colors are pretty and agreeable, when properly applied. As warmth is so essential to all life, it seems natural that in most instances decorative schemes with a warm atmosphere suit our color-sense better than when the colder tints predominate. Take the gray: When used as the principal color, it should be of the warmer shades, and again be relieved by touches of still warmer hues as pink and rose, sometimes warm soft green or gold tones. One speaks of gray in particular as this color usually gives rather a cold impression, but nevertheless the most agreeable and artistic effects are possible in certain rooms, when

executed in the suitable shades of gray and enlivened with other colors as suggested above, although it requires a little more than ordinary care to obtain results.

Pure white is a cold affair; it reflects light very strongly and should always be toned down to the softer shades of ivory and cream.

Black or near-black is seldom used on surfaces other than woodwork, furniture and frames, sometimes as background for ornamental designs which are rich in colors, often found in Pompeian and oriental decorations. Black looks harmonious in small quantities and in combination with rich colors, such as tan, orange, red, and metallic effects; it expresses strength and character; when too much surface is kept in black, it will cause a gloomy aspect.

The bright yellows are not well tolerated when applied in large masses; they reflect strongly, and have an irritable influence; they also reflect an unfavorable tint upon the face. Much more pleasing are the modifications of yellow, like cream, ivory, ecru, tan, the gold and wood tones and browns; all of these should be used extensively.

Red is considered harmful to the eye and irritable to the nervous system in general, although everybody enjoys seeing the pretty red flowers in field and garden and the bright red tints of the autumn foliage. So we learn from nature that when sparingly used and in the right combination, red is rather pleasing. Many people feel very comfortable in a room with red as the predominating color, provided the light is pretty well shaded; and a touch of bright red here and there about the house aids in making things cheerful. Again the reflection from a red surface gives to the individual, especially when of sallow complexion, a more healthful appearance, which in turn exerts a beneficial influence upon the mind. Similar effects are obtained from the various hues, which contain a large amount of red, as pink, rose, and orange.

Green and blue are found in great abundance in nature; both have a soothing influence upon the eye and mind, and are extensively used in decorating, especially the greens. It must be remembered, though, that in outdoor views, colors and contours are seen in a marked degree of perspective. The colors may be very rich, but they will to the experienced observer appear soft and as having that iridescent atmosphere previously referred to. The greens of the field and foliage, the blues of the sky and water are beautiful and very agreeable to our eyes; but the same is true of all other colors as they occur in nature, like the white, gray, drab, yellow, brown, mauve, red, etc. No matter how rich, intensive, and massive the colors of outdoor views appear, we are unable to reproduce the same effect by simply covering the

surfaces of a room with a layer of any green or blue. The sedative influence of blue and green is apt to become rather depressive. Another disadvantage of these colors is the unfavorable reflection upon the face, somewhat similar to that of the mirror with a green tint.

If uniform shades, especially those of saturated colors are used on a large flat wall surface, the retina becomes fatigued by the excessive amount of rays of this particular color. In toning such colors to softer and broken shades, and combining them with other harmonizing colors, they will be much more pleasing and at the same time have a restful influence. The eye objects to having a color made a definite object of observation; and it seems to be most agreeable to the retina when one of the many fields of color-vision takes the leading part and is assisted by other harmonizing color-perceptions.

The sight of one color excites the vision of its complemental or opposite color, as white black, green red, yellow violet, orange blue, and *vice versa.* Take, for example, green and red: a shade of gray may appear quite neutral upon a white surface, but it will display a reddish tint if placed upon a green, and on the other hand a greenish tint on a red background. Too much contrast in color and shading is irritable; too little contrast, or a surface which is too flat, becomes monotonous and tiresome; therefore a happy medium must be chosen.

Let us digress for a moment from the subject of decorating, and give a few suggestions in regard to printing. All paper, used for printing, should have a dull finish and be of a neutral ivory tint, like that of this *Encyclopedia.* White paper and that of the different pale tints, leaning either towards blue, green, or pink, soon become tiresome; and if used alternately in the same book, they have a restless influence. A decided contrast between type and background is of course necessary to make things plain. The most agreeable colors, for type, upon an ivory tint, are the deep saturated brown and the deep broken blue. It has been the writer's experience that on continuous reading, the eye becomes less fatigued when these two colors are used alternately; that is, where the type of some adjoining pages is kept in brown, followed by the same number of pages in deep blue. It goes without saying that for the usual reading matter, type should be large, with sufficient space between the lines, at least three mm. As to the length of the lines, about eight or nine cm. seems the most suitable. Longer lines weary the eye by causing too much strain on the extrinsic muscles; they also make it more difficult to keep track of the succeeding lines. Unfortunately, many books and papers, even such that treat of the eye, have glossy paper and a type which is much too small. It is

hardly believable that this field could have ever been so neglected, causing so much harm to the eyes.

When it comes to interior decorations, it is less difficult to get suitable effects, as it is more or less in the province of the individual to have them carried out properly.

Amongst the most suitable decorations for borders and side-walls are the conventionalized reproductions of repeating landscape scenes, and even more so those with simple foliage effects; they are made in tapestries and wall paper, or they may be hand-painted. Usually one color predominates, either brown, drab, a broken blue or green; others are kept entirely in different tones of either gray, drab, brown, or soft green, etc.

If soft in color and contours, they will make an ideal wall covering; they are pleasing and soothing and afford quite an amount of rest to the accommodation. The ceilings must be carried out to correspond, either blended in the lighter shades of the wall surface or in the proper tints of ivory. The finish of the woodwork is to be in harmony with the wall surface and at the same time give sufficient strength and a constructive character; if there are many dark colors in the decorations, the woodwork should be stained in the deeper shades, avoiding yellow; with lighter schemes the ivory finish goes best, or if a warmer and stronger effect than plain ivory is desired, just the trim may be kept in ivory, and the door wing and the window sill in a rich natural finish.

Another decorative scheme, of which the writer quoted is in favor for living-rooms, dining-rooms, and halls, is the dull glaze finish, which may be mottled in the iridescent browns; a neutral brown or drab is the principal color, which is softly blended with either green or russet, or both; all ceilings to be alike in a neutral dull glaze of ivory.

The so-called two-tone effects in wall coverings, with background and design only slightly differing in shades, are pretty and desirable, provided the colors are not too bright.

In bedrooms and baths the lighter shades are appropriate for wall surface as well as woodwork. A room with plenty of light and air means a clean and wholesome bedroom. Although the selection of the predominating color will largely depend upon individual taste, temperament, and complexion, also the exposure of a room is usually considered. In all cases avoid any real bright colors. Children, normally, love brighter colors than adults, their eyes being stronger and less irritable. People of sallow complexion will favor pink and

rose tints, those with rosy cheeks will prefer the pale blues and greens; others will like creams, tans, lavenders, and a great many will have gray with a suggestion of pink or rose. Any of these will make a suitable wall covering for bedrooms. Neat floral designs and borders make a bedroom quite attractive. Ceilings again and the woodwork should be kept in ivory tints.

When a wall surface is to be finished plain in a uniform tone, then the softer tints only should be chosen, preferably colors of the neutral type.

As curtains are a necessary adjunct to the furnishings of a room, they should be somewhat toned down from the white to ivory, or cream or ecru, whichever will match best with the room. Curtains should also be simple in design, as it is quite disturbing to always strike a mass of scrolls before one can look out of the window. It goes without saying that overcurtains and draperies, when they are used, must also be plain and in harmony with the general scheme.

The most artistic effects are produced in rugs, although an uncomfortable disharmony may be brought into rooms by them if they are of the unsightly, gaudy type previously alluded to.

Pictures are of considerable importance in decorating. A house without pictures would not be very home-like. Whether the subject represented is of a joyous or sorrowful nature, the picture is considered an object of decoration. The pictures and their frames must, like everything else in the room, be in harmony with the general aspect. The wall surface has to be a suitable background; if the latter is too pronounced in color and design, it will not only be objectionable in itself, but also disturbing in conjunction with pictures. A picture is supposed to be an artistic reproduction, be it carried out in colors or in one tone and its modifications, hand-made or otherwise. It is rather discouraging that there is so much inferior stuff manufactured in this line. To produce a good picture, it takes more than a mess of gaudy colors, and a pretentious, frizzly frame will not improve matters. Not everything hand-painted and hand-made looks well. These terms are a great deal abused, often with and sometimes without intention; this tends to mislead many people, who will pay dearly for rubbish, when they could get at the same price, or even less, pictures that possess more real worth, such as prints and photos with neat, well-matching frames. Another objectionable matter in connection with pictures, which one often sees, are the wires or chains and hooks; they of course should be so attached that they become hidden behind the picture.

Naturally one would consider the subject of color-blindness of importance as regards interior decorations. Correct color perception is an essential factor in railway and steamship service. To distinguish between red and green in the execution and supervision of decorations wouldn't mean any more than being able to tell a lamp post from a church tower. Although most people are able to distinguish colors and even the so-called confusion shades, the majority are color-blind to a certain degree, and they are not able to select the proper colors for harmonious combinations, their defect being one of culture as well as sensation. It requires a good deal of study, some artistic feeling, and good vision to create decorative effects which will protect the eye and through it have a beneficial influence upon the nervous system in general and the mind. At best, the eye is a hard working and a much abused organ, and certainly deserves the kindest of treatment. See, also, **Illumination**; as well as **Conservation of vision.**

Interlineation. The spacing between lines of print, typewriting, or handwriting. The subject possesses considerable importance in connection with the conservation of vision, inasmuch as a narrow interlineation is injurious to the eyes of the reader. A proper interlineation is secured, in the setting of type, by what is called "leading,"—i. e., the placing of a thin strip of metal between each line of type and the next one following. (As obtains in this *Encyclopedia.*) When two of these strips are employed, instead of only one, the expression used is "double-leading." "Triple-leading" and and "quadruple-leading" are terms which, now, explain themselves. "Double-leaded" matter is, as a rule, the most comfortable and hygienic for reading.—(T. H. S.)

Interlining. In alphabets and print for the blind (q. v.), this method of writing uses both sides of the sheet. See **Interpointing.**

Intermarginal line. A dark line that runs on the free margin of each line from one canthus to the other, marking the junction of the cutaneous with the tarsal portions of the lid.

Intermittent exophthalmos. See p. 4859, Vol. VII, of this *Encyclopedia.*

Intermuscular cone. The inter-spaces of the orbital contents are filled with adipose tissue, and the whole is bound together by fasciæ. The adipose tissue within the muscular cone is important. Its anterior surface is concave to fit the eyeball and is lined with Tenon's capsule. Adipose tissue is also present outside of the cone, between the muscles and the periorbita.

Internal bi-orbital diameter. The greatest transverse distance between the inner borders of the external orbital apophyses of the frontal bone.

Internal canthus. See **Canthus.**

Internal rectus muscle. See **Anatomy of the eye**; also **Muscles, Ocular.**

Internal reflection. The deflection suffered by a ray of light that is within and impinges upon the inner surface of a transparent medium.—(C. F. P.)

Internal ulcer of the cornea. See p. 3380, Vol. V, of this *Encyclopedia.*

Internasal. INTERNARIAL. Situated between the nasal bones or passages.

International tests, Buchardt's. These charts, like Landolt's, are intended to be universally employed both by literate as well as illiterate people. This subject is fully discussed on p. 4641, Vol. VI of this *Encyclopedia.*

Internodal. Pertaining to the space between nodal points.

Internus. The internal rectus muscle of the eye.

Interobjective distance. The distance between the two objectives of a binocular optical instrument.

Interocular. Situated between the eyes.

Interocular distance. The distance between the two eyepieces of a binocular optical instrument.

Interopticus. (L.) Interocular; as a noun, an interocular lobe observed in certain reptiles.

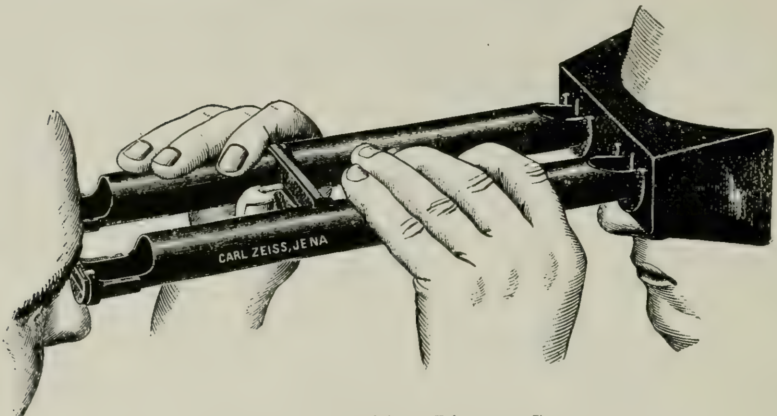
Interorbital. Situated between the orbits; pertaining to the space between the orbits; as a noun, the *interorbital bone.*

Interorbital space. This area includes the nasal and lacrimal bones, the ascending processes of the superior maxillary bones, the frontal below the level of the supra-orbital foramina, and the lateral masses and perpendicular plate of the ethmoid bone.

Interpointing. In alphabets and print for the blind (q. v.), this method of writing uses both sides of the sheet. In interlining, the lines on one side of the paper come in the spaces between the lines on the other. In interpointing, the dots on one side come in the space between the dots on the other.

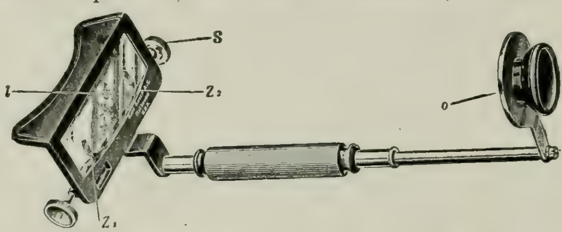
Interpupillary distance gauge. INTERPUPIL MEASURE. An instrument by means of which the distance from the center of the bridge of the nose and the pupil of the eye is measured for each eye separately, thus making it easy to determine any lack of symmetry that may exist with respect to this dimension of the facial anatomy. It is chiefly used for obtaining precise dimensions for spectacle frames, so that each lens may be correctly centered before the pupil of the eye. One of the most accurate was designed by Hertel, and consists of an eye-screen, for the observer, fitted with two parallel tubes having on either end two scales so graduated that the dimensions for reading and distance vision can be ascertained simultaneously. (See the figure.)

Other instruments are described in the legends beneath the various cuts.

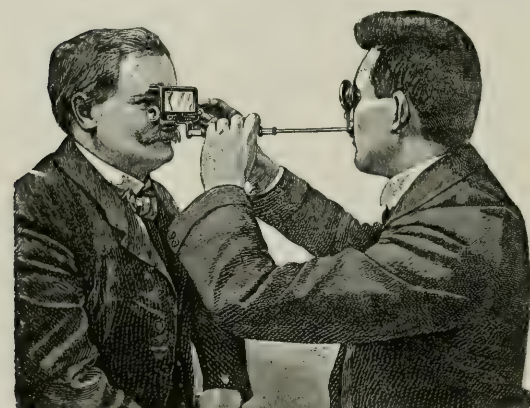


Hertel's Interpupillary Distance Gauge.

Oppenheimer (*Kin. Mon. f. Aug.*, 50, I, p. 570, May, 1912), describes and illustrates his instrument, constructed on the optical principle that the eyes of the patient, corrected for distance, are directed straight

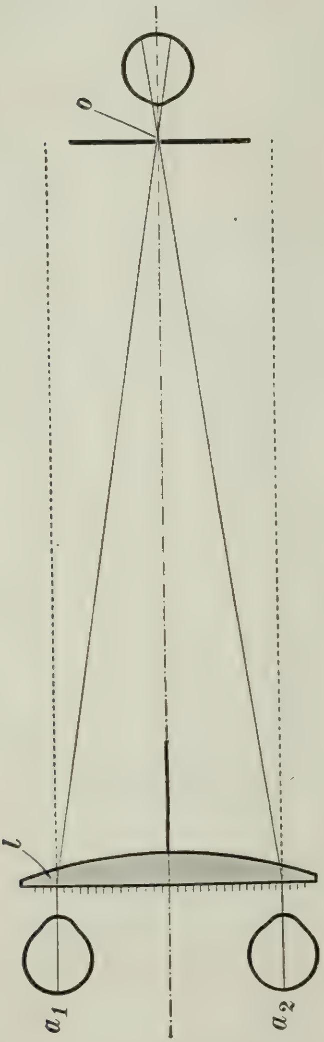


The Oppenheimer Interpupillary Measure.



Oppenheimer Pupillometer.

forward if he sees, through the convex lens of the instrument the cross in the eye-piece of the observer single, as this lies in the focus of the convex lens.



Oppenheimer Interpupil Measure.

a and a, Eyes of the patient; l, convex lens with millimeter scale; o, aperture at principal focus of lens where observer's eye is placed. The patient looking at o through the lens makes his visual axes parallel.

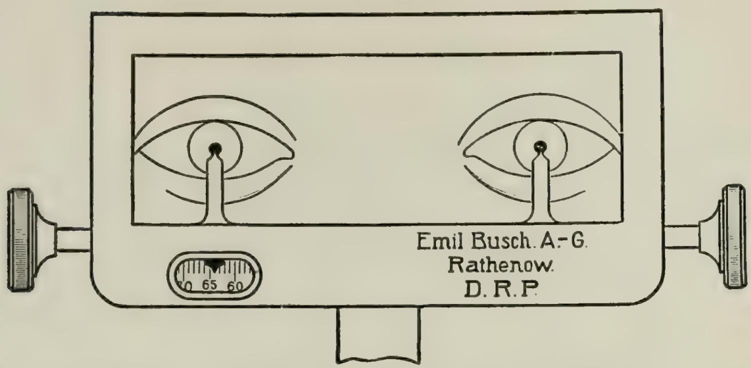
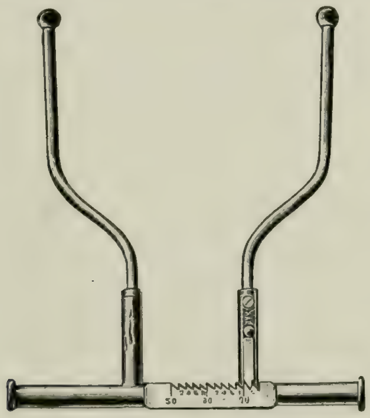
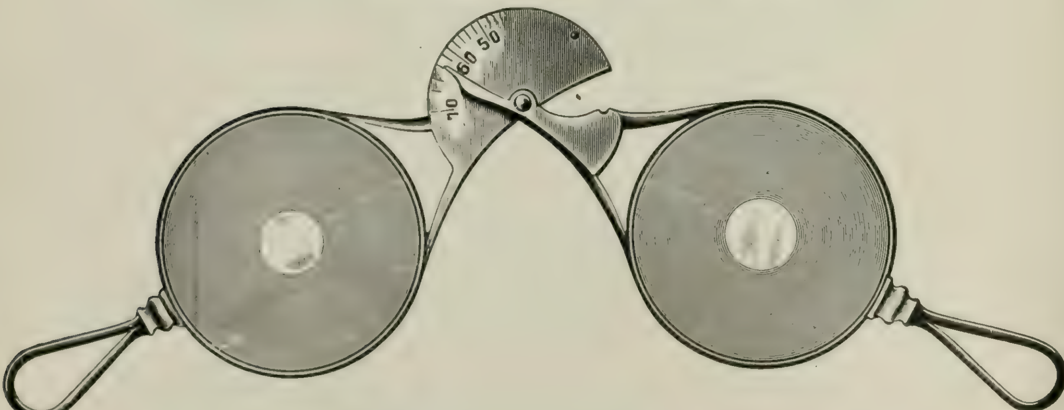


Diagram of the Busch-Oppenheimer Interpupil Measure.
Patient's eyes, movable indexes and millimeter scale, as seen by the observer.

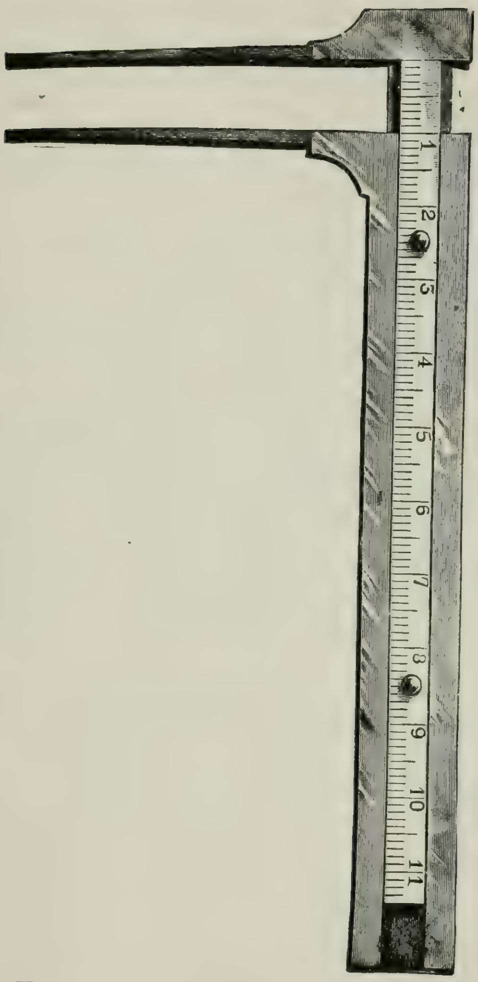


A Simple Device for Measuring the Interpupillary Distance. (Busch.)

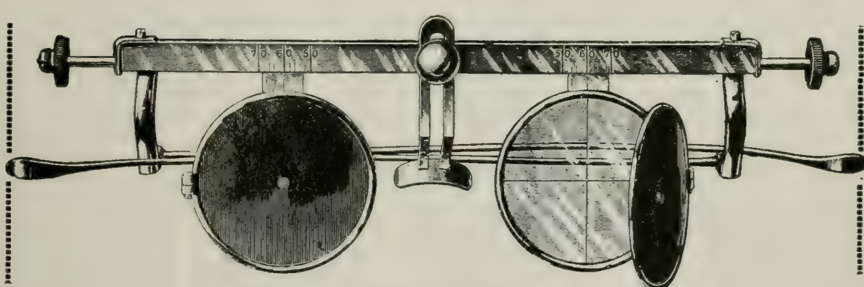


Instrument for Measuring the Interpupillary Distance. (Busch.)

This apparatus consists of two ground glasses with transparent centres mounted in a movable frame. When the eye-holes are directly opposite the pupils the interpupil distance is indicated on the scale.



Horstmann's Interpupillary Distance Measure.



Interpupillary Measurer. (Jung.)

Campos (*Oph. Year-Book*, p. 62, 1911) measures the distance between the visual lines by means of a trial frame with a stenopaic slit in each cell. The cells are displaced before the eyes until the object of fixation is seen singly. A similar procedure determines the base line. The distance which separates the two slits is equal to the base line. See, also, **Examination of the eye**, p. 4617, Vol. VI, of this *Encyclopedia*, in which the apparatus of Maddox for measuring the interpupillary distance is depicted and described.

Intersectio nervorum opticorum. Chiasm.

Interstitial cataract. Lenticular cataract.

Interstitial keratitis. See **Keratitis, Parenchymatous.**

Interstitium ciliare. (L.) Ciliary ligament.

Intersuperciliary. Situated between the superciliary ridges.

Intervaginal space. Between the dural covering of the optic nerve and the inner sheath is the so-called intervaginal space.

Interval, Focal, of Sturm. This observer, in the course of certain theoretical researches on the form of the astigmatic pencil, found that distant objects are seen with the posterior part and near objects with the anterior part of the focal interval.

Intestinal parasites, Eye affections due to. See **Helminthiasis**; also **Parasites of the eye.**

Intestinal sepsis, Ocular relations of. AUTOINTOXICATION. The subjects of this heading are discussed elsewhere under such captions as **Indicanuria**; **General diseases**; **Dyspepsia**, and in particular on p. 707, Vol. I of this *Encyclopedia*. The relations of intestinal intoxication to certain forms of **Cataract, Senile** should also be considered.

Hiram Woods (*Ohio State Medical Journal*, July 15, 1912) affirms that there have been traced to intestinal putrefaction not only choroiditis and various forms of uveitis, but functional and paretic lesions of the ocular muscles, chronic hyperemia of the conjunctiva, phlyctenular lesions, hemorrhagic retinitis, retro-bulbar neuritis. He also says that in cases where it is difficult to get the full or expected effect of a cycloplegic, he has succeeded in getting this effect by a purge and limiting the diet for a few days. He believes that some eye diseases are the result of an intestinal putrefaction proved by indicanuria and that we can eliminate the usual causes of a great many eye diseases, and soon be satisfied that we are dealing with a toxin. We reach this conclusion by the resemblance of eye symptoms to those from infectious diseases. We go further and find associated symptoms strongly suggestive of intestinal intoxication. What the toxin is or if it results from putrefaction of food or bacteria in the intestine, cannot be said. The vast majority of these cases show excessive and persistent indi-

canuria. Treatment based on its presence, and associated intestinal symptoms, results in the relief of the eye troubles. Treatment must, of course, be largely left to the internist. Regulation of diet seems his chief reliance, with such medicines as purgatives, tonics, and the various foods or drugs depending for activity upon the lactic acid bacillus. It is worthy of note that in Herter's experiments injection of cultures of this bacillus was followed by reduction of indol formation. Another phase of the subject is full of interest; the influence of intestinal toxemia upon eye diseases not caused by it.

Intolerance of light. Photophobia.

Intorsion. A form of cyclotropia (generally due to an ocular paralysis) in which the vertical meridian of the affected eye turns in toward the nose. See, **Muscles, Ocular.**

Intoxication amblyopia. See **Toxic amblyopia.**

Intoxication, Saturnine. Lead poisoning and lead cachexia.

Intracapsular extraction of cataract. See p. 1507, Vol. III, of this *Encyclopedia.*

Intracranial diseases, Ocular relations of. See such captions as **Tabes dorsalis**; **Pituitary body**; **Choked disk**; **Brain tumor**; **Cerebrospinal meningitis**; **Cerebellum, Tumors of the**; as well as other **Cerebro**-and **Spinal** headings.

Intracranial operations in ophthalmology. See **Brain tumor**; as well as **Choked disk,** and **Decompression.**

Intracranial organs of vision, Anatomy and physiology of the. The intracranial organs of vision consist of conducting paths and perceptual centers with their association tracts.

The conducting paths for visual impulses become intracranial shortly before the optic nerve enters into the formation of the optic chiasm, this distance being usually less than ten millimeters. At the point where it becomes intracranial the optic nerves are oval in cross section with the longest diameter horizontal. This diameter measures about five millimeters, the shorter diameter about three millimeters. The nerve is surrounded by a sheath of pia mater from which numerous septa extend inward, dividing the nerve into fibre bundles. The arrangement of these fibre bundles is fairly constant. See, also, p. 395, Vol. I; as well as p. 5965, Vol. VIII of this *Encyclopedia.*

The ophthalmic artery enters the cranial cavity immediately below the optic nerve and accompanies it backward in this position. In case of aneurism or atheroma of this vessel the pressure on the nerve may produce considerable distortion. In its posterior portion the

nerve comes in relation to the internal carotid artery and is exposed to pressure from disease of that vessel.

The optic nerve is considered to be composed of three groups of fibres; the papillo-macular bundle, the uncrossed fibres and the crossed fibres. The papillomacular bundle contains fibres from the macula and are the fibres chiefly concerned in central vision. They occupy a relatively small area of the nerve in cross section, about one tenth, but are of the highest functional importance. In the intracranial portion of the nerve they lie near the center, their exact position in relation to the other fibre bundles being a matter of some difference of opinion. The fibres from each macula, in man, go to both sides of the brain, apparently, since hemianopsia due to a unilateral cortical lesion does not involve the macula. In the optic nerve, the fibres coming from the mesial half of the retina lie in the dorsomesial side of the nerve; they are the fibres which decussate in the optic chiasm. The uncrossed fibres, coming from the temporal half of the retina, lie in the outer side of the nerve. It is possible that there are some fibres in the optic nerves that conduct impulses centrifugally; they probably connect the retinæ directly. The existence of sympathetic nerve fibres in the optic nerve has been suggested but not proved. See the figures.

The continuation of the optic nerves posteriorly brings them to the optic chiasm. It was at first thought that all the nerve fibres decussated in the chiasm but in 1826 Johannes Müller showed that this was not true of animals having binocular vision. The course of the papillo-macular bundle in the chiasm and its relation to the other fibres are shown in the accompanying illustration. The optic chiasm lies just in front of the infundibulum which joins the third ventricle to the pituitary gland and anything causing dilation of the third ventricle will cause pressure on the chiasm from above downward and forward. The writer has seen a case of obstructive hydrocephalus due to tumor in the floor of the fourth ventricle in which the great dilation of the infundibulum had caused complete severance of the chiasm, each optic nerve appearing to continue directly on as the optic tract of the same side. Tumors of the pituitary gland cause pressure forward on the chiasm and also laterally on each optic tract. See, also, **Chiasma**, p. 2039, Vol. III of this *Encyclopedia*.

The optic tracts, which continue from the chiasm on each side, are composed of fibres from the macula of each eye and of fibres from the outer or temporal half of the retina of the homolateral eye and fibres from the inner or nasal half of the retina of the contralateral eye. The arrangement of the neuroglia in the optic tracts is the same as in the brain. The optic tracts wind around the cerebral peduncles,

to which they are closely attached, to end in the so-called primary visual centers; the external geniculate bodies, the anterior corpora quadrigemina, and the pulvinar thalami. The relations and terminations of the optic tract are shown in the figure. The external geniculate is certainly the most important of these terminations in connection with vision. In a case of complete absence of the visual system in an adult, reported by Wm. G. Spiller (*Brain.* 1901, p. 631), the external geniculate bodies were absent, whereas the anterior colliculi were practically normal in size and the pulvinar of the thalamus almost as large as normal. Spiller also showed that the sub-thalmic body, the habenula and the internal geniculate body, probably are not part of the visual system. Ferrier and Turner (*Brain.* 1901, p. 27) also showed, by animal experiment, that the corpora quadrigemina are

Cross Section of the Optic Nerve Showing Arrangement of Septa and Relations to the Ophthalmic Artery.

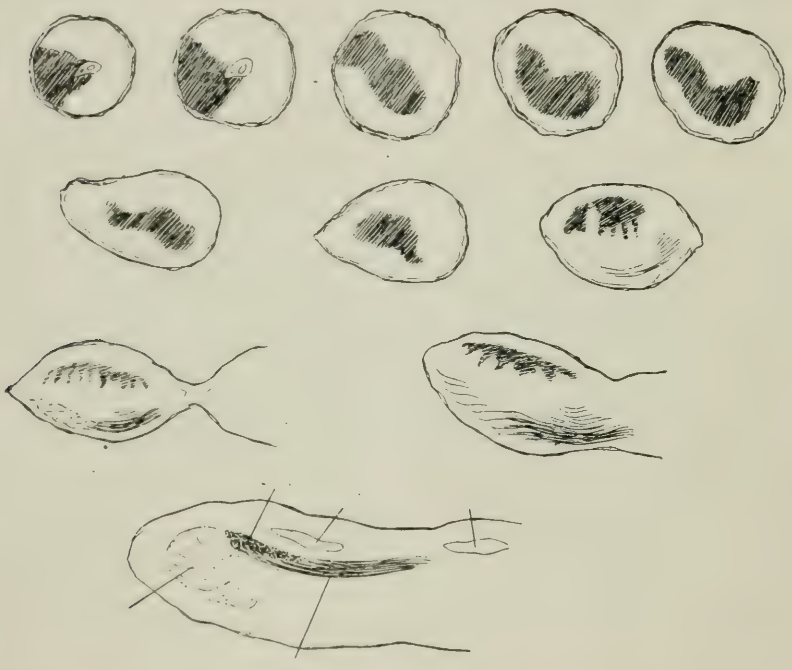
not essential parts of the visual system, at least in the higher vertebrates.

The optic fibres, as they pass into the external geniculate body, divide into strata.

Visual impulses are carried from the primary optic centers to the cortical or perceptual center by the so-called optic radiations of Gratiolet or thalmo-cortical bundle. This fibre tract arises from the pulvinar of the thalmus and the external geniculate body and is at first a compact bundle running horizontally backward. It is separated from the posterior horn of the lateral ventricle by the tapetum, while on its outer aspect it comes in relation to the inferior longitudinal fasciculus. The fibres gradually spread and end in the occipital cortex in the calcarine fissure and its vicinity.

That part of the cortex included in the calcarine fissure and the convolutions forming it above and below may be called the primary cortical or perceptual center of vision. The researches of Brodmann

and others show that this area has a peculiar architecture which differs from other parts both in cell and fibre arrangement. There are nine cell layers in this region as compared to six in most other parts of the brain. A striking peculiarity, visible with the unaided eye, are the so called striæ Gennari, or Vicq d' Azyr, which appears as a fine striation parallel to the surface of the cortex. The extent of these striations is somewhat variable but they are probably coextensive with the area of cortex concerned with the direct visual perception.



The Course of the Papillomacular Bundle in the Optic Nerve and Chiasm.

It has been demonstrated by Henschen (*La Projection de la rétine sur la corticalité calcarine.* Paris, 1903) that in the left hemisphere the upper lip of the calcarine fissure is in relation to the upper quadrant of the left retina and the under lip with the lower quadrant of the left retina; and the other side corresponds. The projection of the macular region on the visual cortex is not yet worked out.

The whole of the occipital pole is more or less concerned in vision, association fibres connecting all these parts together. It is possible that in adjacent convolutions there are special centers for color-vision, as cases of hemiachromatopsia have been observed, but the existence

of these special centers is denied by some authorities. See, also, **Fissure, Calcarine.**

In the region surrounding the posterior end of the first temporal convolution, known as the angular gyrus, there is a center for the seeing of words as words and the recognition of their meaning. The center is only in the left hemisphere in right-handed individuals. The term ''center'' in this connection is used to denote an anatomic area in which this function appears to reside, leaving open the question as to whether it is represented by a group of cells or is simply a place full of association fibres concerned with this function. There is also a center, or centers, for object recognition. The inferior longitudinal bundle probably is the most important connecting link between the visual cortex and other parts of the brain, especially with the temporal lobe. The writer has observed two cases in which the interruption of this path has caused an inability to name objects seen, though the objects were recognized and the name of the object recognized when spoken. In one case there was a subcortical brain tumor (autopsy findings), in the other a subcortical brain abscess (operation).

According to Wilbrand and Sänger crossed amaurosis due to unilateral lesion of the brain has not been observed. A case of this kind was reported by Mills and Camp (*Amer. Jour. of Insanity,* V. lxii, No. 1), in which there was accompanying visual hallucinations. The writer has observed several cases in which lesion of the lateral surface of the occipital lobe apparently caused concentric contraction of the visual field and dimness of vision in the contralateral eye. These cases may be explained by the generally accepted theory that the higher visual centers in the occipital lobe are connected not only with the calcarine area on the same side but, also, by commissural fibres, with the calcarine cortex of the opposite side, this bilateral representation, however, being more marked for central, i. e. macular, vision, than the peripheral vision.—(C. D. C.)

Intracranial pressure. See **Decompression; Choked disk** and **Brain tumor.** By means of lumbar puncture Heine (*Ann. of Ophth.,* Vol. 23, p. 167, 1913) tested the intracranial pressure in twenty-five cases of nystagmus. In seven there was a slight increase, in nine a somewhat greater one, and in two a marked rise. Of the twenty-five cases nineteen were positively and two probably of congenital origin, the inference being that there was a cerebral affection with increased intracranial pressure and meningeal irritation. In six cases gradual reduction of intracranial pressure acted favorably on the nystagmus. Increased intracranial pressure was also found in

most of the twenty-five cases of neurotic disease of the cornea, including herpes corneæ, herpes zoster, keratitis dendritica, keratitis bullosa, keratitis neuroparalytica, and dystrophia epithelialis. In a few cases excellent results followed lumbar puncture.

Intracranial tumor. See **Brain tumor.**

Intradural tumors. Primary neoplasms affecting the optic nerve proper, i. e. within the dural sheath, are quite rare. The first case was reported in 1833 by Wishart, while Byers (*Studies from the Royal Victoria Hospital, Montreal,* 1901) has collected reports of 102 cases. The most common form of these new growths is the myxo-sarcoma, the next most frequent being the myxo-fibroma. See also a case of primary intradural tumor of the optic nerve reported by Ellett (*Journ. Am. Med. Assocn.,* p. 104, July 8, 1916).

This subject is fully discussed under **Tumors of the eye** and under **Optic nerve, Tumors of the.**

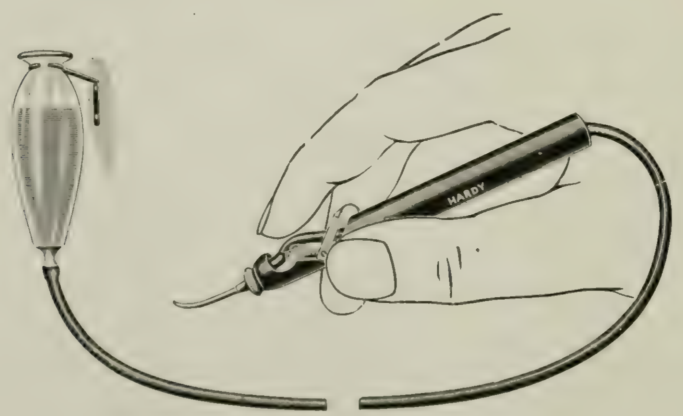
Intramuscular injections. This form of subdermal medication is by many preferred to the usual hypodermic injections, although the reaction from it is generally more marked than in hypodermatic treatment. For massive or oily mixtures intramuscular medication seems preferable to the hypodermic form.

Intraocular. Situated or occurring within the eye, as intraocular tumors.

Intraocular irrigation. This caption is discussed on page 1667, Vol. III, of this *Encyclopedia.*

Reference may also be made here to the intraocular irrigator of Greenwood (*Prac. Med. Series,* p. 223, 1907).

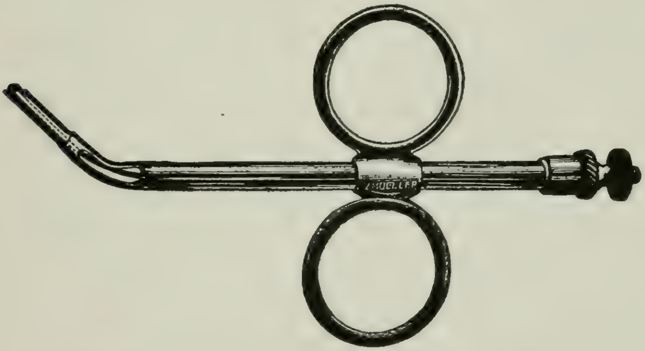
This apparatus consists of a glass bottle with a connecting rubber



Intraocular Irrigator.

tube. The latter passes through a light metal handle, which is perforated near the end to enable the operator to compress the tube with his finger and regulate the flow. The irrigating tip is attached to the end of the handle. This tip is round and bent to enable its being readily passed into the anterior chamber. A small rod spans the convexity of the bend, which serves to hold up the flap, thus enabling the return flow of fluid and cortical masses to escape readily.

Intraocular medication. INTRAOCULAR INJECTIONS. The introduction of therapeutic agents into the anterior chamber and vitreous by injection has not been received with much favor. In 1887-8 Abadie and Galezowski injected a solution of mercuric chlorid into the vitreous, hoping to disinfect the bulbar region by bringing a powerful germi-



Mark Stevenson's Intraocular Powder Introducer.

cide into actual contact with the infected area. Although the results of this experiment were not favorable, other attempts, with weaker solutions of sublimate, cyanide of mercury, argyrol, iodoform emulsion, etc., have proved more successful. Haab, as is well known, has published encouraging reports of his method of introducing rods and discs of iodoform (q. v.) in substance into the ocular interior, especially to combat infected penetrating wounds of the cornea and bacterial invasions of the uveal tract and vitreous.

H. V. Würdemann injects 50 per cent. argyrol solutions into the anterior chamber through corneal incisions or wounds and has thereby saved many eyes with hypopyon iritis.

Under the proper caption will also be found an account of Koster's attempt to cure intraocular tuberculosis by the injection into the anterior chamber of sterile air, after aspiration of a portion of the aqueous humor.

An intraocular powder introducer is the invention of Mark Steven-

son (*Ophthalmic Record,* October, 1906). One is able to see how much powder is introduced, as the amount present can always be observed. Little or nothing can be known about a fluid except the amount injected, as some or all may escape. Powders are not washed out of the eye so readily as a fluid. The latter may flow out of the eye in a few minutes with the aqueous and the operator can not ascertain how much remains. The powders used dissolve slowly, thus continuing their effect for some time. Discs or pencils are liable to act as foreign bodies and cause irritation of the posterior surface of the cornea, the delicate iris, or the anterior capsule of the lens. For this form of intraocular medication he prefers powdered iodol to iodoform.

Intraocular optic neuritis. See **Choked disc.**

Intraocular pressure. See p. 2256, Vol. III, of this *Encyclopedia*; also **Heart disease, Eye symptoms in**; the introduction to **Glaucoma**; **Blood-pressure**; **Tonometry**; and under the heading **Examination of the eye.**

Intraocular tension. See **Intraocular pressure.**

Intra orbital. Within the orbit.

Intraorbital injections. See **Injections, Intraorbital.**

Intrapolar magnet. See **Electromagnet.**

Intraretinal. Situated within the substance of the retina.

Intrastromal. Within the stroma of an organ.

Intrauterine ocular diseases. PRENATAL EYE DISEASES. In addition to the matter under **Congenital anomalies**; **Ante-partum ophthalmia,** and allied headings the attention of the reader is called to a discussion of this subject by Parsons (*Pathology of the Eye,* p. 772) in which he points out that while prenatal abnormalities are generally attributed to either arrest of development or intrauterine inflammation both these theories offer considerable difficulties. So far as the latter hypothesis is concerned the term "inflammation" must be used in a wider sense than usual, for there can be no question of inflammation, in the restricted sense, in early embryonic life, because that involves conditions of the tissues, e. g., a fully-developed vascular system, which are as yet absent from the embryonic structures. Probably the most conclusive evidence in favor of intrauterine inflammation as a cause of congenital malformation is to be found in congenital anterior staphyloma.

As an example of probable *intrauterine uveitis* William Campbell Posey (*Annals of Ophthalm.,* April, 1913) reported the case of an infant with congenital pseudoglioma in the right eye and coloboma of the iris with ophthalmoscopic signs of an old choroiditis with secondary atrophy of the optic nerve in the left eye. The conditions

were present at birth, the eyes being free from signs of inflammation at the time. Posey attributed the condition to an inflammation of the mesoblastic tissues concerned in the formation of the embryonal eye, in consequence of syphilis in the mother. The condition of pseudoglioma which existed in the right eye was, in his experience, unique.

Intravenous injections. This form of medication—the injection directly into a superficial vein of various soluble salts for the purpose of obtaining a more rapid or more pronounced result in eye disease—has been highly recommended by several surgeons of repute, notably by members of the French school of medicine. The following estimate by Darier (*Thérapeutique Oculaire*) of this form of therapy is well worth consideration.

Injection of the soluble salts of mercury, and particularly of the cyanide, is a difficult procedure, but in skilled hands has advantages of the first order, i. e., absence of pain; rapid and exact action; no local lesions (infiltrations, etc.) so often following intramuscular injections, and no serious sequels.

The solution should be thoroughly aseptic, and contain no cocain or any other analgesic, as these act violently on the heart and nervous centers. The solution he recommends is as follows: Hydrarg. cyanid, 0.33; Sod. chlorid, 0.08; Sod. phosphat, 0.07; Aquæ dest. et steril, 100.00. Two or three cc. are to be injected into one of the veins at the bend of the elbow, taking care to give the injection slowly.

The technic is simple, almost as easy as intramuscular or hypodermic injections. There are persons in whom the veins are difficult to find. In these cases it will be necessary to have recourse to subcutaneous or intramuscular injections.

Proceed as for a phlebotomy, when one applies one or two turns of a bandage tightly around the arm above the biceps. During the venous stasis, wash the site of the injection with cotton soaked in chloroform, alcohol or sublimate. Pass a fine platinum needle with iridium point through a flame; then introduce it cautiously into the vein. Before injecting aspirate slightly to see if the blood can be drawn into the syringe. If blood appears in the syringe one can be sure that a false passage has not been made. The bandage is then released, and nothing remains but to slowly (4 or 5 seconds) push the liquid into the vein. The patient complains at most of a sensation of chilliness; or occasionally of a taste of bitter almonds. The needle is to be withdrawn quickly, and slight compression made with a tampon of cotton over the puncture. A drop of collodion will then seal the orifice.

Make the injections in each arm alternately so as not to weaken

the vein, which after a great number of punctures will thicken, and at that spot become painful to further injections. This is the chief objection that has been found to intravenous medication, but it is always time to return to the hypodermic plan when the venous method does not permit the continuance of the treatment.

Nervous patients have, the first time, some apprehension, especially if the injection is made too rapidly or if it seems to them that the physician is not sure of himself, but such drawbacks are entirely compensated by the advantages.

In using cyanide of mercury, one should not neglect before each new injection to ask the patient if he has experienced, since the last injection, any colic or diarrhea. In either event the dose should be diminished or the injections made less frequently.

After the first series of thirty injections they should be discontinued for a month; then resume with a second series, and even a third. Sometimes, in certain chronic affections like keratitis parenchymatosa, choroiditis and irido-choroiditis, one may be obliged to give, in the course of two or three years, from one to two hundred injections.

Darier has given thousands of intravenous injections, without complication, except occasionally a slight periphlebitis, where a little of the liquid had escaped outside of the vein. The entrance of air bubbles into the veins of the arm is without danger; he has injected a syringe full of air without inconvenience.

Complications are exceedingly rare. An infectious phlebitis has never, Darier maintains, been observed, and it is hardly possible if the needle has been previously sterilized by heat. He has found it well, to prevent the rapid tolerance established by the organism to any one medicinal agent, either to vary the mode of application (inunctions, hypodermic injections, deep injections, sub-conjunctival injections), or to change the salt. Thus, he makes a first series of twenty to forty intravenous injections of the cyanide of mercury; then allows three months of rest; then he gives a new series with a biniodide (0.01 increasing gradually to 0.03). If a third series is necessary, and we have to deal with one of those forms of tertiary syphilis with intractable cutaneous complications, or bony lesions, he has recourse to another salt of mercury, enesol, for example.

Enesol is a salicylarsenate of mercury, very soluble, rapidly eliminated by the urine, seventy times less toxic than the biniodide, and is employed for injection in a 3 per cent. solution. It causes little pain.

A centigramme of enesol is equal to 0.0087 of the biniodide. A cubic centimeter of the 3 per cent. solution contains 0.0115 of metallic mercury, corresponding to 0.026 of the biniodide.

Darier has given intravenous injections of enesol of one to two cc. with most favorable therapeutic results, and has also employed it in subconjunctival injections frequently without provoking the least ocular or intestinal irritation. It may cause slight soreness of the gums after ten days' treatment.

In subconjunctival injections, enesol is less painful than the cyanide, while in hypodermic injections it looks as if it will replace all known salts requiring as an adjunct an analgesic of some sort; cocain, acoin, or subcutin.

The intravenous use of the mercurial salts rendered Darier such service, that after reading the essay of Mendel, he did not hesitate to administer the salicylate of sodium by the same method. This salt he employed in iritis, episcleritis and other rheumatic affections of the eye, 0.50 to 0.60 daily into one of the veins at the elbow. With these doses of 0.60 as the maximum, he obtained better results than with three or four grammes of the salicylate or aspirin given internally.

Credé has demonstrated the bactericidal power of collargol in affections caused by streptococci, staphylococci, etc. He utilized it in intravenous injections of 0.08 to 0.12 centigr. of a 2 per cent. solution, in many infectious conditions with excellent results and Darier now holds with Credé that this mode of application by intravenous injection is the only true way.

DeLapersonne has treated, by means of intravenous injections of collargol, certain forms of purulent iritis due to systemic infections. In one case the hypopyon completely disappeared, and the case was cured by a single injection.

In traumatic cases, equally good results are obtained by collargol, but if panophthalmitis has been once established of course nothing can stop it.

Parke, Davis & Co., in describing the employment of one of their syringes for intravenous injection advise that the patient be in a recumbent position; a standing or sitting posture would produce syncope. The skin over the median basilic or median cephalic vein at the flexure of the elbow should be thoroughly cleansed. The syringe, armed with a needle not larger than 26 gauge nor longer than 5/8 inch, should be sterilized by boiling and charged with the quantity to be injected. The arm just below the shoulder should be compressed in its circumference firmly by an Esmarch bandage, a rubber band or tube, or if these are not at hand a firm cotton or linen bandage may be employed. The bandage should not be tied, but simply held tightly with perhaps a single knot which can be instantly loosened by the assistant, who should be in charge of this

part of the work. The object of compression of the arm, of course, is to engorge the veins. Although the median basilic vein is larger than the median cephalic, it is in close relationship to the brachial artery, from which it is separated only by fascia, and the danger of wounding the artery by an accidental transfixion of the vein with the needle suggests, therefore, the advisability of choosing the median cephalic vein.

The operator firmly grasps the arm of the patient with his left hand, seating himself comfortably at the side of the bed so that he is not in a constrained position. With the filled syringe, from which the air has been carefully expelled, in the right hand, the barrel of the needle is placed directly over the center of the vein, parallel to its long axis, and is then pointed toward the vein, being held at an acute angle with the axis of the vessel. Then firmly but gently the point of the needle is forced through the skin with a gentle lifting motion until the sense of touch indicates that it has entered the vein. The needle should be forced through the skin into the vein so slowly that there will be no possibility of wounding or piercing the distal wall of the vein.

When the needle is thought to be safely in the vein the syringe should be held perfectly still for a few seconds, when the appearance in the solution of a small stream of dark blood will indicate that everything is in readiness for the injection. Some operators withdraw the piston of the syringe slightly to induce the entrance of venous blood into the syringe, but this is unnecessary. Others prefer to introduce the unattached needle, and after it is proved to be in the vein to attach the syringe. This is not considered as good technique as the method described above, and it is more difficult to carry out. The danger of the needle slipping when attaching it to the syringe is entirely overcome by the recommended procedure.

When the needle is in the vein, the left hand of the operator is shifted from the posterior aspect of the arm to the anterior surface, where the needle can be held firmly in position. Then the piston should be forced down with a screwing motion, turning it around and pushing it forward at the same time. This controls the injection of the remedy much more perfectly than is possible by holding the syringe in the ordinary manner and making pressure on the piston with the thumb and counter-pressure on the barrel with the first two fingers. The injection should proceed with extreme deliberation and slowness, not more than 1 cc. of the remedy being injected in one minute; it should require two minutes to inject 2 cc., etc. The injection of 5 cc. should require five full minutes. It is advisable to have

an assistant with a watch note the time, with frequent promptings, because time passes so slowly under such circumstances that one minute seems like ten, as has been proved by many experiments.

The constricting bandage around the arm at the shoulder should not be released until the needle is in the vein. The injection should not be begun until the constriction is released; in other words, when the operator has the needle in the vein and is ready to begin the injection he should direct the assistant to release the bandage—carefully, however, so as not to disturb the position of the needle point which is in the vein. When the bandage has been released the injection should be begun, but not before.

The patient should abstain from food for about three hours previous to the injection, as the reaction may cause vomiting; he should remain in bed in a recumbent position for two or three hours after the chill has subsided, as collapse may follow getting up too soon. In the aged or when the patient is weak or his condition bad, stimulation at the time of injection is good practice. One-thirtieth grain of strychnine hypodermatically, or other stimulants, may be given as required.

Observe most carefully these cautionary notes: They are essential to the proper care of the syringe and to insure its readiness for use.

The syringe should be made entirely of glass and should be handled with care. Do not test the syringe by drawing up the plunger and releasing it suddenly; the concussion will fracture the barrel. The syringe may be sterilized by boiling or by rinsing it with a 5 per cent. solution of cresylone or carbolic acid or with bichloride solution. The best method of insuring genuine sterilization is by boiling for at least twenty minutes. In boiling the syringe always first remove the plunger and the metal finger rest. Place the separate parts of the syringe in a suitable vessel, cover with cold or tepid water and bring to a boil; boil for twenty minutes and allow the syringe to cool in the solution before using. Do not boil the syringe without first removing the plunger and finger rest, or it will break. The boiling will not break the syringe if it is put into cold water and brought to the boiling point. Do not pour boiling water on the syringe; this will break it. After boiling do not cool by pouring cold water on the syringe; this will break it. When the plunger sticks, boil the syringe in a solution of 25 parts of glycerin and 75 parts water, to loosen the piston, then rinse and wipe dry as directed below. After using, rinse the syringe by drawing in and expelling several syringefuls of plain cold or tepid water, then with a clean cloth dry the plunger and the inside of the barrel. Unless this is done after each injection any

attempt to release them will result in breaking the plunger or the barrel, or both. The syringe may be used for aspirating, but no matter how used it should be thoroughly cleansed and wiped dry after each injection. If this is not done, trouble will invariably result and is no fault of the syringe. If the directions are followed carefully, no trouble can possibly result and the syringe will always be in readiness for use.

Intrinsic magnifying power. See **Magnifying power.**

Intumescence. A swelling, normal or abnormal.

Intumescent cataract. This term is usually applied to those cases of senile cataract that develop rapidly with much swelling of the lens and, occasionally, with the occurrence of acute glaucoma. See, also, **Index myopia.**

Inula chinensis. A plant species found about China, having stimulant, and sedative, properties. The juice, or the coarsely powdered herb, is applied to carbuncles, deaf ears, and sore eyes.

Inunction. The act of rubbing in ointment; friction with the hand to facilitate the cutaneous absorption of liniments, salves, etc. See, for example, the mercurial ointments.

Inustion. A burning in; deep cauterization. A caustic; also the heat of inflammation.

Inustorium. (L.) A cautery.

Inversion of the eyelid. Entropion.

Inversion of the image. It is known from the laws of optics, and from experiments, that the image formed upon the retina is inverted; yet it is perceived as an upright object. Why is it that objects are seen erect when their images are inverted? Without discussing the question extensively it is sufficient to say that it is the result of lifelong habit. A person born blind, and remaining in that condition for many years, as a result of a successful operation, has his sight given him, but is unable by this sense alone to tell the difference between a cube or a sphere, a dog or a cat. All objects appear to him as flat. Soon, however, aided by the sense of touch, he appreciates form, and, guided by experience, he soon learns to view the external world normally. By touch the individual corrects his mental impression, and soon the brain learns to make the correction independently. In discussing this question Helmholtz said that, since "our natural consciousness is completely ignorant, even of the existence of the retina and of the formation of images, how should it know anything of the position of images formed upon it?"—(J. M. B.) See, also, **Learning of vision.**

Inversion, Visual. One of the manifestations of this condition is

"mirror-writing," in which the person copies or writes upside down or, in drawing, depicts objects inverted.

Arps (*Ann. of Ophth.*, Vol. 23, p. 482, 1914) reports a case of double inversion. The patient was a boy of seven years, but tested out at six years of age by the Binet-Simon scale of intelligence. He was of questionable parentage, the mother being illiterate, profane, and intemperate, and having a record of immorality prior to her marriage. When induced to attempt to copy writing from the blackboard, he invariably perceived the letters upside down and backwards. This was true not only of letters and of their position in words, but equally so for all the numerals except the unit sign and the cipher. It could not be determined that there were any corresponding inversions in the objects of his environment. When words were written upside down and backwards, the boy always copied them right side up and forwards. At the time of report he had largely learned to overcome the difficulty. Bourgeois reports the case of a person who had learned to read with the page turned upside down and could do so as rapidly as with the letters in the usual position. See **Mirror-writing.**

Invertebrata. A collective title for those animals that do *not* exhibit the characteristics of vertebrates, *viz.* a dorsal nerve-cord, a dorsal median supporting axis or notochord, respiratory clefts on the pharynx, a ventral heart, and *eyes arising for the most part as outgrowths of the brain.* However, the dividing line is not as clear as it once seemed; not only are Ascidians or Tunicata recognized as degenerate vertebrate or chordate animals, but several "worm" types, among Nemerteans and Chetopods, approach vertebrates in some of their characters, while Balanoglossus and Cephalodiscus are so near the boundary line that they are usually called hemi-chordata or half vertebrates. See **Comparative ophthalmology**; as well as **Insects, Eyes of**; **Worms, Eyes of**; and **Spots, Eye.**

Inverted cilia. ENTROPION. A condition in which the eyelashes or the free margins of the lids are turned in upon the eyeball so as to irritate it. See, also, **Cilia, Misplaced.**

Inverted image. In *optics*, an image whose various parts are reversed with respect to its center and the location of corresponding parts in the object. See, also, **Image.**—(C. F. P.)

This term is sometimes applied to the indirect method of *ophthalmoscopy.*

Invisibility, Means of procuring. In the folk-lore and the fables of almost every country appear again and again various supposedly certain means of procuring invisibility. Of these peculiar methods

we can here make a list of the more important only. See, for example, regarding *heliotrope,* both the stone and the herb so-called; Boccaccio's "*Decameron,*" Eighth Day, III, and Virgil's "*Georgics,*" XL; also Gyge's ring, mentioned by Plato; fern seed, very commonly referred to as a begetter of invisibility both by Shakespeare and other Elizabethan dramatists, and Albric's cloak, *Tarnkappe,* mentioned in the "*Niebelungen Lied.*" The *blood of a dog* and the *capon-stone* called "Alectoria" have also been at times declared to be possessed of the power of conferring invisibility. Finally, and the best known of all instances, comes the wondrous *cloak of Jack the Giant Killer.*—(T. H. S.)

Invisible spectrum. Those parts of the spectrum which are due to rays of a refrangibility, greater or less, than the eye can perceive.

Iodalbin. A compound of iodin and blood albumin containing 21.5 per cent of iodin: used like iodids. Dose, 5-10 gr. (0.3-0.6 gm.).

Iodalgin. A proprietary substitute for iodoform, soluble in water.

Iodallylene. A substance, C_3H_3I, obtained by the action of an aqueous solution of iodine and potassium iodide on allylene, and occurring as a liquid of penetrating odor, strongly irritating the eyes and mucous membranes. It boils at 98° C.

Iodalose. A proprietary preparation of iodin with peptone.

Iodamylformol. An antiseptic preparation of iodin, thymol, starch, and formaldehyd.

Iodamylum. An iodized preparation of starch: a surgical antiseptic.

Iodan. A proprietary preparation of iodin in goose-grease.

Iodanisol. A yellow-red, crystalline substance, $C_6H_4(OCH_3)I$: antiseptic and rubefacient.

Iodanthrak. An absorption product of iodin and animal charcoal: used like the iodids and externally as a dusting-powder for wounds.

Iodargyr. An organic iodin and silver preparation for the treatment of wounds and ulcers.

Iodarsyl. A solution of sodium iodid and sodium paramidophenylarsenate: used for intravenous injection.

Iodic acid. See **Acid, Iodic.**

Iodide of potassium. See **Potassium iodide.**

Iodile. A crystalline organic compound of iodin: used hypodermically in syphilis, goiter, and tuberculosis.

Iodin. I. IODINE. IODUM. TINCTURE OF IODINE. COMPOUND SOLUTION OF IODINE. LUGOL'S SOLUTION. CARBOLIZED SOLUTION OF IODINE. CHURCHILL'S TINCTURE. DECOLORIZED TINCTURE OF IODINE.

Iodine and its soluble preparations are generally incompatible with starch, oil of turpentine, tannin and the vegetable colors.

With the earlier ophthalmologists painting the forehead, lids and temples with the ordinary tincture of iodine was a favorite counter-irritant in scleritis and other acute and chronic diseases of the eye associated with pain. It was also used as an application to the skin of the ocular region affected with erysipelas. The employment of tincture of iodine (or any of the preparations mentioned above) as a cauterizing agent and germicide to corneal ulcers of the simple type has been advised by several authorities. The Editor has used it with good effect and if the globe and sac be well irrigated with a mild disinfectant and the ulcer curetted, there is no better agent for completion of the cure than one or two thorough applications (by means of a pointed toothpick soaked in the solution) of any of the iodine preparations.

Painting the lids with tincture of iodine is still a favorite remedy with some surgeons. Thus, Puech advises it to remove the deposits in all forms of deep scleritis, applying the remedy daily for five days. This procedure is occasionally employed in chronic iritis and other inflammations of the uveal tract. Its action is, of course, that of a counter-irritant.

In the preparation of the patient for ophthalmic operations involving a skin surface—the eyelids, for example—painting the dermal field of operation with simple tincture of iodine is a ready antiseptic application highly to be commended. It is an effective substitute for other forms of antisepsis, such as washing with ethereal soap-suds, bichloride solutions, White's ointment, etc., although simple cleansing may properly precede the iodine application.

For operations upon the eye "Vaporole" of iodine tincture, made by Burroughs, Wellcome, and Co., is exceedingly suitable. Each of these little glass receptacles contains twenty minims of a 3 per cent. tincture of iodine. The thin end of the tube is covered with absorbent wool, enclosed in a silken cover. When the thin end of the phial is broken under the cover, the iodine is taken up by the wool, which is then used as the medium for applying the iodine to the parts.

Orechkin has recommended 5 per cent. alcoholic tincture of iodin with brilliant results in numerous ophthalmologic operations. The patient's lids, portion of forehead, corresponding side of the nose, cheek and temporal region were painted with the 5 per cent. tincture. Moist regions and the eye secretions are dried previous to the application of the iodin solution. The latter must be always freshly prepared. The burning sensation caused by the iodin may be quite severe, in spite of preliminary cocainization, but disappears in a few minutes. After the painting with iodin, the conjunctival sac, in

operations on the eyeball, is flushed copiously with a sterile 1:5000 solution of cyanide of mercury. None of the writer's 237 cataract operations gave suppuration, while with other antiseptic methods he had suppuration in 2 per cent., with subsequent loss of the eye. In 1,200 other operations on the lids and adjacent portions only in five cases was there suppuration in the sutures, and he explains this complication by the low grade of intelligence of the majority of his patients. He comes to the conclusion that Grossich's method of disinfection of the operative field is the best and that it should be given preference also in ophthalmic surgery.

Dewaele (*Trans. Belg. Oph. Soc.*, April 28, 1912) has used iodine in the form of an ointment, with an anesthetic, as a disinfectant of the cornea, notably after the extraction of foreign bodies. The formula is as follows:

Stovain, 15 centigrams, finely pulverized and dissolved in five drops of official oil; add, after mixing, preferably over a water bath: Lanolin, 5 grams; vaselin, 10 grams; add gradually the following solution: Iodine, 15 centigrams; iodide of sodium, 30 centigrams; aqua, 1½ grams.

Bonnefoy (*Ann. d'Ocul.*, Vol. 151, p. 470, 1914) has used the iodin vapor bath of Longe, obtained by heating iodoform in a special ampule. The resulting violet vapor is said to have a complex composition and to act especially by its colloidal character. In the eye it causes more or less lively pain, edema of the conjunctiva, and at times a fibrinous exudate, congestion of the free margin of the lids, hypersecretion of the glands of the lids, and a secretory reaction of the lacrimal gland. Vaporized iodin is supposed to give relief to chronic affections of the lacrimal sac, to have a beneficial effect in affections of the lids (especially ulcerative blepharitis), and to have a decided action on ulcers of the cornea and in trachoma with pannus.

Finally, one must not forget the use of this agent in suppurative dacryocystitis and lacrimal fistula, especially in Wessley's method of injecting tincture of iodine through the fistule until a drop or two passes through the punctum into the conjunctival sac. By the careful employment of a number of these injections a cure is sometimes effected in suitable cases.

Iodin amblyopia. See **Iodism.**

Iodin bichloride. ICl_2. This is an orange-yellow, deliquescent, crystalline powder, with a pungent, irritating odor. It is distinctly poisonous. It melts and decomposes at 25° C., and both in substance and solution must be protected from light and air.

Its bactericidal power has been tested experimentally by several ob-

servers on typhoid, cholera, diphtheria, streptococci, staphylococci, tubercle bacilli, etc.; a 0.1 per cent. solution was found to be only slightly less efficacious than a 3 per cent. solution of carbolic acid, while the latter was considerably inferior to a 1 per cent solution of trichloride of iodine.

In ocular therapy Felser has successfully employed, where an external astringent and antiseptic was indicated, a 0.02 per cent. solution.

This agent, like the trichloride, is a cauterant in simple forms of corneal ulcer and if the preliminary cleansing and other accessory precautions in the treatment of this disease are regarded it is a reliable agent for the purpose. For subconjunctival injections Pflüger advises a 1:2000 to 5000 solution in water and Birnbacher uses it instead of sublimate for cleansing purposes, 1:1000 solution, in follicular conjunctivitis.

Iodin caustic. See **Iodine.**

Iodin reaction. One of the useful purposes that iodin subserves as a reagent is in placing sections in Lugol's solution, diluted with 3 parts of water, for from 3 to 10 minutes. The sections are then washed and examined in glycerin. The degenerated areas are stained brownish-red, while the unaffected tissue is yellow. The brownish-red color is rendered still more brilliant if 25 per cent. of glycerin is added to the solution. This stain is not permanent.

If a section has been treated as mentioned above, and is then placed in a 1 per cent. strength solution of sulphuric acid, the brown color will become more saturated, or become violet, blue, or greenish. Sometimes some of these colors can be seen with the iodin treatment only.

Iodin trichloride. ICl_3. This salt is an orange-yellow, deliquescent, crystalline powder, with a pungent, irritating odor. It is distinctly poisonous. It melts and decomposes at 25° C., and both in substance and solution must be protected from light and air. The agent in its pure form is a cauterant for the simpler forms of corneal ulcer, and if the preliminary cleansing and other accessory precautions in the treatment of this disease are regarded it is a reliable and efficacious application. For subconjunctival injections Pflüger advises a 1:2000 to 5000 solution in water and Birnbacher uses it instead of sublimate for cleansing purposes: 1:1000 solution, in follicular conjunctivitis.

Iodine-vasogen. VASOGEN. J. A. Andrews used this remedy in corneal opacities and infiltrations. He employs it in 5-10 per cent. mixture, making the application on a cotton-tipped probe, every other day until the infiltration shows signs of shrinking; then, according to indications, it may be applied every third day. Sometimes this remedy causes decided pain even in milder solutions. For this reason Andrews

prepares the eye by washing it with normal salt solution, afterwards instilling a 2 per cent. solution of alypin. Before applying the iodine-vasogen, the excess tears should be carefully wiped from the eye, with cotton.

A. Duane also believes that this is a valuable application for the removal of corneal opacities. See, also, **Vasogen.**

Iodinophil. Any cell or other element readily stainable with iodin.

Iodipin. An iodin addition-product of sesame oil, said to contain 10 per cent. of iodin. It is a yellow liquid: used in asthmatic affections, bronchitis, etc., also subcutaneously in tertiary syphilis. Dose, 15-60 min. (1-4 c. c.).

Iodipsol. A proprietary compound of iodin, oxymethylene, and resol: used in intestinal disease and externally as a dusting powder.

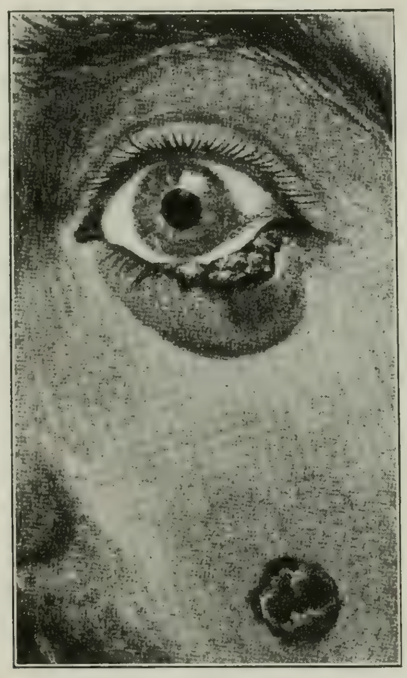
Iodism. The train of symptoms, such as malaise, frontal headache, coryza, lacrimation, pharyngitis, acne, hydroa, etc., which follow the prolonged excessive use of iodine alone or in the form of iodides.

In a case of sudden total blindness following the application of iodin to a Colles fracture, seen by Bernstein (*Ophthalmology,* Vol. 10, p. 41, 1913) the blindness came on within four weeks after the accident. Ten days after the accident teno-synovitis developed and the tincture of iodin was applied. The blindness was bilateral, sudden and accompanied by paralysis of both elevators and superior recti. The pupils were contracted. The fundus had the pallor of pernicious anemia. The arteries were thread-like and the veins engorged. One month later the fundus was normal, vision equaled light perception. The possibility of double embolism and of iodin poisoning as causes are considered.

An interesting case of tubercular iodism simulating gumma of the lid and presenting diagnostic difficulties is reported by Sydney Stephenson (*Ophthalmoscope,* p. 406, July, 1914). The patient, aged 30, gave a history of gonorrhea in November, 1906, lasting until March, 1907. Toward the middle of March, 1907, a spot came out on the right knee, and was followed by others on the forehead, right forearm, left upper arm and, toward the end of that month, by "sores" on the legs. In June or July the patient's throat became ulcerated.

On August 14, a diagnosis was made of tertiary syphilis. When the writer saw the patient on December 4, 1907, his condition was as follows: The outer half of the left lower eyelid was red and swollen but not tender. At first sight, the appearance reminded one of an abscess in the substance of the eyelid. On palpation, however, it was obvious that the tissues of the lid were infiltrated, and the condition recalled a gummatous process. Another infiltrated area was

present in the substance of the left cheek, one inch or so above the upper lip. Below the left jaw was a carbuncular looking mass, discharging pus by several fistulas. The right ear showed a scaly eruption, not unlike eczema. On the back of the scalp, situated over the occipital bone, was a crusted sore. A number of pigmented, supple, superficial cicatrices, possibly the remains of cutaneous gummata, present over the right knee, both legs, left thigh, left buttock, and right forearm.



A Case of Tubercular Iodism. (Sydney Stephenson.)

The infiltrated lesions of the lower lid, cheek, etc., simulated gummata, but it became quite clear that they were really that rare form of iodism known as "tubercular iodism." This seemed plain from the notes of Dr. Walsh who had previously attended him: The patient was treated locally with ammoniated mercury ointment and internally with potassium iodide (grs. 10) and citrate of iron and ammonia (grs. 10) thrice a day. His attendances at the hospital were somewhat irregular, having been registered on the following dates: August 28, September 25, October 19, and November 16. On the last-named date the potassium iodide was discontinued owing to the existence of "well-marked iodide papules on the face, etc."

The patient stated that a small swelling, an "iodic papule," had existed toward the center of the left lower eyelid for about a fortnight, and that the swelling had become greater during the three days before he consulted Stephenson.

Boric lotion and oleate of mercury (10 per cent.) were applied to the affected lid. The further progress of the case is as follows: "The left lower eyelid is now tender, and the disease process has extended to the whole of that structure. There is a definite ulceration of the upper aspect of the outer end of the swollen lid."

Later: "The outer half of the left lower lid is now ulcerated, and the rest of the lid is infiltrated. The parts are tender. The likeness to a gumma becomes more and more pronounced. Sajodin, one gramme twice a day, administered internally, and the ulcerated surface to be treated with iodoform."

Still later: "The condition, as shown in the sketch, has improved. The left lower lid is occupied by a reddish swelling, more marked in the outer half than elsewhere, and the parts are slightly tender. A shallow ulcer, with clean-cut, non-indurated edges and nodular floor, occupies the upper part of the outer half of the affected eyelid. It measures 3 cm. by 1 cm. The other sores, one on the left cheek and the other below the left side of the chin, are also in process of healing."

In a month's time the ulceration of the left lower lid had almost healed, and the infiltration of the parts was much less marked. The other lesions were also doing well.

Finally, the ulceration of the lower lid healed, but there still remained some reddening and thickening of the outer half or two-thirds, with a few scales of desquamating skin at the lower part of the thickened area.

Of the various skin lesions that may on occasion follow the internal administration of potassium iodide, that described in the present communication is probably the rarest. At one stage the resemblance to gumma was most misleading. The writer finds the following remarks on the subject in the fourth edition of Dr. Norman Walker's "*Introduction to Dermatology*" (p. 69).

"In rare cases the lesions produced are at first solid, and later break down in a manner so similar to the gumma, that one or two patients have been dosed into their graves by the pushing of the very drug which was the original cause of their trouble. In others, large solid tumors have developed, leading to the mistaken diagnosis of malignant disease or even leprosy."

In reference to the present case a couple of points appear to be worthy of notice: First, that the potassium iodide had been discon-

tinued eighteen days before the patient was first seen by Stephenson; and, secondly, that the several lesions healed under the administration of another iodine compound, namely, sajodin.

Iodistol. See **Aristol.**

Iodized carbolic acid. See **Iodine**, and **Phenol, Iodized.**

Iodized collodion. See **Iodine.**

Iodized glycerol. See **Glycerine.**

Iodofan. C_4I_4NH. MONOIODODIOXYBENZOL-FORMALDEHYD. This is a complex organic compound produced by the action of iodine on formaldehyd and dioxybenzol. It forms a reddish-white powder, without odor or taste, which is recommended as a non-irritating antiseptic dressing for operative and other wounds, either as a dusting powder or ointment. It possesses bactericidal action, stimulates the healing processes and acts, generally, as an iodoform substitute.

Iodoform. FORMYL TRIIODIDE OR TERIODIDE. TRIIODOMETHANE. CHI_3. This well known antiseptic is manufactured by various processes; one of these is by heating together iodine, potassium carbonate, alcohol and water. It crystallizes as minute, yellowish, hexagonal scales that are almost insoluble in water but dissolve in alcohol, ether, benzene and most of the volatile oils. It is unctuous to the touch and has an iodine-like taste and a most disagreeable, penetrating odor. On the market one finds the crystals just described and two forms of powder—the one quite light and the other heavy. As the microscopical crystals are not well adapted as a dusting powder for wounds and ulcers, either of the powders should be employed.

Local poisoning (iodoform eczema) as well as general disturbances are sometimes noticed. In the former instance irrigations of hot water and the application of calcined magnesia are the best remedies.

Many attempts have been made to disguise the smell of this valuable remedy, so obnoxious to eye patients. Ohlemann believes this is best accomplished by combining it with cumarin. The National Dispensatory gives iodoformum aromatisatum, deodorized iodoform, as containing four per cent. of cumarin. It also states that the odor of iodoform may be removed by washing in an aqueous solution of tannin. For this purpose, also, the N. D. mentions 3 to 5 drops of oil of peppermint to the ounce. Peru balsam, oil of fennel and oil of anise are also effective. The odor of the drug clings even to instruments and dishes. These should first be rubbed with turpentine and then washed with soap and water.

Owing to the poisonous and ill-smelling qualities of iodoform numerous compounds, claiming to be as efficacious an antiseptic but less poisonous and malodorous have been suggested from time to time.

Among these may be mentioned iodoformogen, aristol, iodol, iodolen, iodolin, iodogallicin, iodoformin, iodylin, xeroform, isoform powder, antiseptol, europhen, losophane, the sozoidolates of sodium, lead, potassium, zinc, mercury, lithium, aluminum and magnesium—especially the first—sulphaminol and thiophine. Any of these agents that have been successfully employed in ocular lesions are referred to elsewhere in this *Encyclopedia* under their proper captions.

Iodoform is, on the whole, most efficient when applied as an extremely fine powder by means of an insufflator to wounds, corneal ulcers, to the parts involved in plastic operations, in diseases of the lachrymal sac, caries of bone, etc. It is also valuable as an ointment in the proportion 1:20 to 1:10. Dissolved in collodion it makes an excellent dressing for wounds of the ocular region. In the form of gauze iodoform is extremely useful for packing sinuses or as a dressing in evisceration of the orbit. In disease of the bone associated with dacryocystitis iodoform mixed with glycerin or oil has been recommended as an injection. In all these preparations it should be as finely divided as possible; there should not be visible even with a powerful lens the minutest crystals, for if present they act as irritants and one loses to some extent the purely antiseptic action of the drug.

H. Bailey uses the following ointment as an application in phlyctenular keratitis and corneal ulcer: Pulv. iodoform., ℈i; Atropia, gr. ii; Lanolin., ℥i; to be thoroughly mixed in a mortar.

For the hyperemia of the conjunctiva and the irritative symptoms that sometimes accompany refractive errors and that occasionally persist after they have been properly corrected Hanford McKee prescribes iodoform powder on a homatropin and cocain disc, or a little ointment of iodoform—ten per cent. strength.

In wounds of the cornea and ocular region generally C. L. Frey uses a 2 per cent. solution in olive oil.

In addition to the use that every surgeon makes of this old and valued remedy (as a disinfectant dressing for operative and other wounds) Haab introduces into the anterior chamber small rods or discs of iodoform for the treatment of most forms of intraocular infection. He advises their use when the anterior chamber has been infected by pathogenic bacilli—as in hypopyon ulcer for example. They will also be found valuable in some cases of traumatic infection where, otherwise, enucleation would be indicated.

A number of cases of iodoform amblyopia are reported in the literature.

Sarafoff describes a case of retrobulbar neuritis which occurred after two injections of iodoform emulsion for psoas abscess, each containing

30 gm. of pure iodoform. Vision was reduced to finger-counting, but returned to normal, and the central scotomata disappeared. Experiments of Palermo, on rabbits and dogs, have shown that iodoform produces an interstitial inflammation of the nerve.

Rochon-Duvigneaud describes the case of a young man who had received, after evacuation of an inguinal abscess, an injection of iodoformated glycerin, 6 to 7 grammes of iodoform having been absorbed. Six months after the injection of the iodoform the disturbances of vision began. Examination of the eye-ground demonstrated at this time the existence of an optic neuritis, having the characters of an infectious neuritis. The vision was much diminished, and there was a central scotoma. In the discussion, Sauvineau recorded an observation of papillitis, which manifested itself by a central scotoma, in iodoform poisoning. See, also, **Toxic amblyopia.**

Iodoformal. A fragrant yellow powder prepared from iodoform and ethyl iodid, and used like iodoform.

Iodoform albuminate. See **Iodoformogen.**

Iodoformin. An odorless substitute, $C_6H_2N_4CHI_3$ for iodoform. It is a white powder, from which 75 per cent. of iodoform is set free by contact with a wound.

Iodoformogen. Iodoform albuminate. This is an odorless mixture of albumen and iodoform. It occurs as a fine, dry, yellow, voluminous powder which slowly liberates iodoform and does not form clots when in contact with the tissues. It is reported to be an effective, non-toxic and convenient substitute for iodoform. It ought to be an excellent dusting powder and application to wounds in eye surgery.

Iodol. Tetraiodopyrrol. Pyrrol tetriodide. C_4I_4NH. This agent is a pale, yellow-brown, bulky, odorless, tasteless, partially crystalline powder—the oldest (1885) of the iodoform substitutes. It contains 90 per cent. of iodine, and is sparingly soluble in water; more soluble in alcohol, ether and the fixed oils.

Thomalla recommends this remedy as a fine powder to be dusted on the cornea in phlyctenules of that organ. He regards it as a valuable substitute for calomel, while as an iodine preparation it can (dose, 5 to 15 grains) be taken internally at the same time.

It has been recommended as a dusting powder in herpes corneæ.

In chronic catarrhal conjunctivitis a small quantity of the following ointment has been advised for finger massage of the lid skin on the globe: Iodol, 2.00 (ʒss); Petrolatum, 10.00 (ʒiiss).

A similar use of iodol is made in follicular conjunctivitis, the salve being dispensed as follows: Iodol, 2.00 (gr. xxx); Petrolatum; Lanolin., āā 5.00 (ʒi gr. xv.); Ol. rosæ, gtt. i.

Iodomethylphenylpyrazolon. See **Mydrol.**

Iodomuth. A reddish-brown powder, $Bi_2C_{15}H_{12}I_2O_{12}$: a bismuth preparation containing 25 per cent. of iodin. It is a stimulant, antiseptic, and healing agent. Dose, 5-30 gr. (O. 333-2 gm.).

Iodonucleoid. A brownish powder, insoluble in alcohol, ether, and acids, being a combination of iodin with nuclein. Recommended in syphilis and said to be practically non-toxic.

Iodophen. TETRAIODOPHENOLPHTHALEIN. A yellow, antiseptic powder, $C_6H_4C_2O_2$ $(C_6H_2I_2OH)_2$, soluble in alkalis, slightly so in alcohol, ether, and chloroform, but insoluble in water: used externally as a substitute for iodoform.

Iodophenol. Iodin, 20 parts; phenol, 76 parts; and glycerine, 4 parts: antiseptic.

Iodophilia. The reaction shown by leukocytes in certain conditions when treated with iodin or iodids. Normal leukocytes are colored bright-yellow, but in certain pathologic conditions, as toxemia and severe anemia, the polymorphonuclears show diffuse brownish coloration. When the staining affects the leukocytes themselves, it is termed intracellular; when only the particles around the leukocytes are affected, it is extracellular. (Dorland.)

Iodopin. IODIZED SESAME OIL. As it is usually found in the market this mixture contains ten and twenty-five per cent. of iodine. The latter mixture is intended for hypodermic use—the dose being 2 to 6 c. c. (30 to 90 minims) daily.

Although probably only a mixture of corn oil (oil of sesame) and iodine it is offered as a substitute for the sodic and potassic iodides so largely used in ophthalmic therapeutics. The drug seems to be well borne even for long periods of time. Its elimination is very slow, traces of it remaining in the urine 53 days after administration. It may be given by mouth in 10 per cent. strength, six teaspoonfuls a day, or as the oil inclosed in capsules. It may also be employed hypodermically in as large doses as 10 to 15 cc. of the 25 per cent. solution every two or three days. It can also be administered by inunction. Iodopin, indeed, may be given for all the conditions for which iodide of potassium has been used.

Iodosan. This agent is described by Ruata (*Archiv. di Ottalm.*, p. 225, 1914) as a 3 per cent. solution of iodin, not in association with iodid, not precipitable with water, as is tincture of iodin, and having the property of developing, when diluted with ordinary water (not distilled water), iodin in the atomic state. From experiments on rabbits the author states that the new preparation has an energetic action on the ocular tissues. The absorptive and penetrating power of a solution

of iodosan is greatly superior to that of a common iodin solution containing about the same percentage of iodin, since the solution of iodosan, administered by conjunctival instillation, gives a characteristic reaction for iodin in the aqueous humor much more intense than that obtained with analogous instillations of iodin-iodid solution. From experience in fifty clinical cases the author states that iodosan has a decidedly favorable effect in various corneal affections, whether lymphatic or bacterial in origin. Its power is most marked in the first stage of the disease, and after two or three doses, used for primary sterilization, it should be followed by the usual routine treatment.

Iodosol. See **Aristol.**

Iodostarin. According to the proprietors (E. Merck's *Annual Reports,* p. 254, 1912) this drug has been prescribed in a variety of eye diseases, such as affections of the retina and choroid, of the vitreous humor and the cornea, in which preparations of iodine are usually given, Beck (*Münchener medizinische Wochenschrift,* 1912, No. 41, p. 2232) prescribed iodostarin, directing his attention more especially to the manner in which the preparation was tolerated when given in daily doses of 1 to 3 grammes (15—45 grains) for a prolonged period. In one case only he observed unilateral headache on the day following the administration of the first dose. As this persisted on leaving off the drug, the author does not attribute it to the medicament. In another case slight signs of iodism occurred. Otherwise Beck, in spite of careful observation, met with no unpleasant secondary effects among his patients. He usually gave 8 to 10 tablets a day; in acute cases at the beginning of treatment sometimes up to 15 tablets. Later 6 to 8 tablets a day sufficed. The author considers the action not inferior to that of the alkaline iodides. E. Saalfeld (*Deutsche medizinische Wochenschrift,* 1912, No. 42, p. 1988) is of opinion that iodostarin is superior to potassium iodide in many respects, as it is more slowly excreted, its action being thus protracted, and it seldom gives rise to harmful secondary effects. S. Makler (*Dissertation,* Zürich 1912) also states that it is as a rule well tolerated, but cases may occur which show signs of severe iodism. When given by mouth, it appears after a short time in the urine and saliva. A part is retained in the organism and about 88 per cent. is excreted. The excretion in the urine and feces occurs only in the form of inorganic salts of iodine. The accumulation of iodine in the body may be explained, according to Herzfeld and Makler, (*Medizinische Klinik* 1912, No. 35, p. 1428) in that the iodine ion, set free from the organic compound, becomes attached to other organic complexes, so that the liberation of iodine is not absolutely essential.

Iodosyl. This proprietary agent is said by the owners (Nelson, Baker & Co.) to be a definite chemical compound containing a little over 65 per cent. of iodine, whose formula may be written empirically, $C_7H_4O_3I_2$. It is a bulky, amorphous, garnet-colored, odorless powder; non-irritating and does not stain the skin; insoluble in water and oils, slightly soluble in chloroform, alcohol and ether. It is said to be a powerful antiseptic and deodorant, decidedly analgesic and without toxic properties. The claim is made for it that it is of value in the treatment of purulent ophthalmia, granular lids, ciliary blepharitis, pannus and ulcer of the cornea. For this purpose an iodosyl ointment containing 2 per cent. of the drug in collapsible tubes is on sale. It may, however, be employed in greater strengths up to 6 per cent. or even 10 per cent.; or be used as a dusting powder.

H. McI. Morton places a small quantity of the salve in the conjunctival sac as an adjunct to the treatment of several forms of conjunctivitis, mainly for the purpose of preventing the lids from sticking together and allowing the secretion to drain away.

Iodum. See **Iodin.**

Ioduret. This compound is said by Baar (*Des Gesichtfeld,* p. 173, 1896) to have produced an amblyopia similar to that set up by iodoform.

Ion. Ions are the components into which an electrolyte is broken up in electrolysis. The one, the *anion,* travels "against" the current towards the anode or positive electrode; the other, the *kation,* travels "with" the current to the cathode. The terms were suggested by Faraday. See **Electricity.**

Ionic medication. IONTHERAPY IN EYE DISEASES. IONIZATION. IONTOPHORESIS. CATAPHORESIS.

The therapeutic introduction of ions into the human tissues by means of electrolysis has still a number of advocates. Among the earlier of those who reported good results from such remedies is Wirtz (*Klin. Monatsbl. für Augenheilk.,* Nov.—Dec., 1908) who says that in 1846 Klenke claimed that he cured "scrofula" by introducing iodine into the system by means of electricity. From time to time other workers have proved that substances can really be introduced into the body by this method. Animals have been quickly killed by driving solutions of alkaloids through the skin by electricity, whereas the same solutions merely applied to the skin are quite inert.

Krüchmann, more recently, treated syphilitic iritis and choroiditis by iontophoresis, using salts of mercury.

In contrast to Krüchmann, who attempted to treat deep-seated diseases, Wirtz has confined himself to diseases of the superficial parts, the cornea, conjunctiva, and edges of the lids. He experimented with

a number of different ions on the rabbit's eye and discovered what dosage is safe for the cornea and conjunctiva respectively. He then proceeded to test their efficacy in diseases of the human eye.

He describes a series of special electrodes for its application to the eyeball, lids, etc.; and reports the clinical results in 38 cases, 59 diseased eyes, to which 576 applications were made. His most important results were attained in diseases of the cornea. He also treated cases of episcleritis, trachoma, chronic blennorrhea, pneumococcus, diplobacillus and lacrimal conjunctivitis, with benefit.

The use of electrodes (especially those of Wirtz) in iontherapy is described and depicted under **Electrodes, Ophthalmic** on p. 4235, Vol. VI, of this *Encyclopedia*.

Still later, in the treatment of serpent ulcer, Sabowski (*Klin. Monatsbl. f. Augenh.*, p. 389, Sept., 1911) uses Wirtz's smallest electrode, with a 1 per cent. solution of zinc sulphate, and 2 ma. of current, and continues the application two minutes. Among ninety cases forty-eight required but one such treatment, twenty required two, fourteen were treated three times; five four times, two five times, one had seven applications, and one case required the galvanocautery. Forty-seven cases at the time of discharge had vision of 5/24 or better. In fifteen it was reduced to counting fingers or less.

Zahn (*Klin. Monats. f. Augenh.*, p. 105, July, 1911) also reports his experience of iontophoresis in sixty-three cases of serpent ulcer, fourteen of purulent keratitis, and seventeen of dendritic ulcer. In serpent ulcer a single application usually checks the course of the disease, and in dendritic ulcer results were obtained not possible by other methods. In scleritis, parenchymatous keratitis and inflammations of the iris and ciliary body, it also proved of value. The applications to the cornea were made with a .05 per cent. solution of zinc, and 1 ma. of current, continued for one minute. He had also obtained good results in corneal herpes.

Macnab (*Lancet*, p. 821, March 22, 1913) had good results follow ionic medication of herpes zoster ophthalmicus. He introduced sulphate of quinin by means of the positive pole over the whole area affected, for 15 to 20 minutes, using a current of 1 to 1.5 ma. per square inch of surface. Usually two applications at an interval of 7 to 10 days were made to the skin area, and the conjunctiva was treated separately for a shorter time and with a weaker current. The neuralgic pains and the disturbance of local sensibility were cured almost immediately, and the iritis was relieved. See, also, Vol. II, p. 1438 of this *Encyclopedia*.

Ionium. A supposed element of radio-active properties discovered in uranium metals.

Ionization. IONISATION. See **Ionic medication.**

Ionophose. A violet phose, or phosphene.

Iontherapy. See **Ionic medication.**

Iontophoresis. See **Ionic medication**; also **Electrodes, Ophthalmic.**

Iosol. See **Aristol.**

Iothion. DIIODOHYDROXYPROPANE. $C_3H_5I_2(OH)$. A yellowish, heavy, oily liquid, soluble in from 70 to 80 parts of water, 20 parts of glycerine and 1.5 parts of olive oil. Very soluble in alcohol and ether, lanoline and petrolatum. In from 5 to 15 per cent. ointment it has been recommended as an application in blepharitis. Internally, as inunctions and in the subcutaneous form, it has also been prescribed for vitreous hemorrhages, choroiditis, iritis and optic atrophy in about the same dosage as iodine.

Ipecac. IPECACUANHA. This well-known emetic and expectorant agent is the powdered dried root of several plants. Lewin und Guillery (*Die Wirkungen von Giften auf das Auge,* Vol. II, p. 774) mention a number of cases of which, in addition to conjunctival injection, there are other eye symptoms, probably due to the vomiting brought on by irritant doses. The cornea became ulcerated, the pupils contracted and motionless. The visual acuity was in one case reduced to light perception.

Iperforia. (It.) Hyperphoria.

Ipermetropia. (It.) Hypermetropia.

Ipsolateral. HOMOLATERAL. Occurring on the same or the corresponding side.

Iralgia. (Obsolete.) An old term for pain in the iris.

Ireoncion. (L.) IRIDONCUS. (Obs.) Swelling of the iris.

Ireoperisphinxis. (Obsolete.) The operation of drawing the iris from all sides in toward a central point, and there fixing it, so as to form an artificial pupil.

Irian. Of, or pertaining to the iris.

Iriancistron. IRIANKISTRIUM. IRIANKISTRON. A hook-shaped instrument once used in the operation for artificial pupil by separation.

Iridadenosis. (L.) (Obsolete.) A supposed glandular disease of the iris.

Iridæmia. IRIDEMIA. (L.) Hemorrhage from the iris.

Iridal. Pertaining to the iris.

Iridalgia. (L.) (Obsolete.) The pain and annoyance caused by the presence of isolated synechiæ in the iris.

Iridallochrosis. (L.) (Obs.) A change in the color of the iris.

Iridal retina. This name is given to that part of the retina that supplies the iris and which consists of two layers, an anterior layer with spindle-shaped pigment cells and a posterior layer with polygonal cells.

Iridaréosis. (F.) Atrophy of the iris.

Iridauxe. Iridauxesis. (L.) Old term for a tumefaction or hypertrophy of the iris, usually from exudation of fibrinous matter into its tissues.

Iridavulsion. Iridodialysis. The total removal of the iris by tearing it from its peripheral attachment.

Iridectome. An old name for any instrument adapted for the formation of an artificial pupil; also a knife used in iridectomy.

Iridectomedialysis. An old term and method, suggested by I. A. Schmidt, of making an artificial pupil, which consisted in detaching a portion of the iris at its periphery, and excising the portion so detached.

In more recent times it has been shown (Parsons) when the iris is torn away, as in iridectomy for glaucoma, the rupture of the iris tissue takes place at the extreme periphery of its base; in other words, the most peripheral iridectomy is obtained by this method of iridectomedialysis. In acute glaucoma mere apposition of the iris to the cornea, or even slight adhesion, will be quite insufficient to prevent the iris tearing away in this situation. In this manner the filtration angle is re-opened, the congestion of the ciliary processes, etc., quickly subsides, and normal tension is restored and maintained.

Iridectomirt. (G.) A person on whom iridectomy has been performed.

Iridectomize. To remove a part of the iris.

Iridectomy. An operation, the object of which is to remove a piece of the iris. Its indications are many and varied. Originally it was performed for optical purposes only (by making an artificial pupil) and thus permitting light to penetrate into the interior of an eye in which the pupillary area for some reason is not sufficiently transparent for this purpose. It was later on found that an iridectomy may also be a curative agent, especially in eyes with increased intraocular tension (von Graefe); also for the removal of foreign bodies, tumors, etc.

The first iridectomies were performed by Daviel, who occasionally removed a piece of iris during his cataract extractions (de Wecker; *Reminiscences Historiques. Arch. d'Ophtalm.*, Vol. XIII, 1893). Wenzel (*Traité de la cataracte,* 1788) performed iridectomies for optical purposes only. However, in excising (within the anterior

chamber) the iris, he frequently caused a traumatic cataract. This led him to advise the removal of the lens, whether opaque or transparent, immediately after performing the iridectomy.

Abscision of the iris after having drawn it outside of the cornea,—*precorneal iridectomy,* was introduced by Beer (Wien, 1806). A corneal flap was made with the long triangular knife which bears his name, then, by means of a sharp hook he pulled the iris out through the corneal incision and cut it off. While this procedure has been varied and improved upon in different ways in modern times Beer's method is the prototype of all forms of iridectomy.

OPTICAL IRIDECTOMY.

The instruments necessary for performing an iridectomy are (1) some form of blepharostat, unless the lids, as some prefer, are held apart by an assistant's fingers. (2). Fixation forceps. (3). A lance-shaped triangular knife (keratome) or von Graefe cataract knife. (4). Iris forceps or blunt hook. (5). Some form of iris scissors. (6). A thin spatula. The various forms of these instruments will be found under their appropriate headings in this *Encyclopedia.*

Whether it is best to dilate the pupil before making an iridectomy depends on certain circumstances. It is surely contra-indicated in cases with increased intraocular tension. It may be of value when otherwise it would be impossible to see the pupillary edge. In other cases, as for instance, in zonular cataract, the writer has found it of decided advantage. In such cases it is well to dilate the pupil first to find out whether vision will thereby be improved, and to determine the best location for an iridectomy, and then to let the pupil contract again before operating.

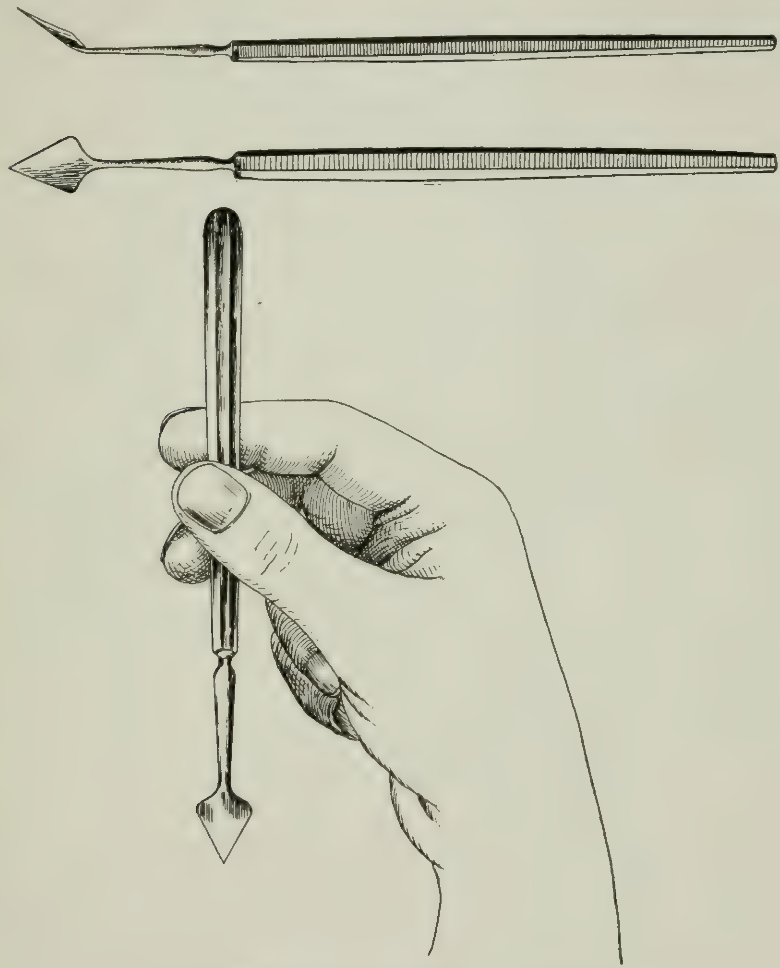
Except in children and very nervous individuals a general anesthesia is not required. The instillation of a solution of any of the local anesthetics (q. v.) with the addition of a few drops of adrenalin (epinephrin) is all that is required.

The conditions present in each case must determine the position chosen by the operator. However, in most cases the surgeon stands behind the head of the patient, and somewhat to one side.

It is, of course, necessary that the field of operation should be well illuminated. When daylight is not sufficient one of the numerous forms of electric lamps (see **Lamp**) is a great help.

The lids are separated either by a blepharostat or by an assistant's fingers; the conjunctiva and episcleral tissue are grasped with a fixation forceps close to the corneo-scleral margin, either below, or somewhere at the corneal periphery opposite to the intended incision,

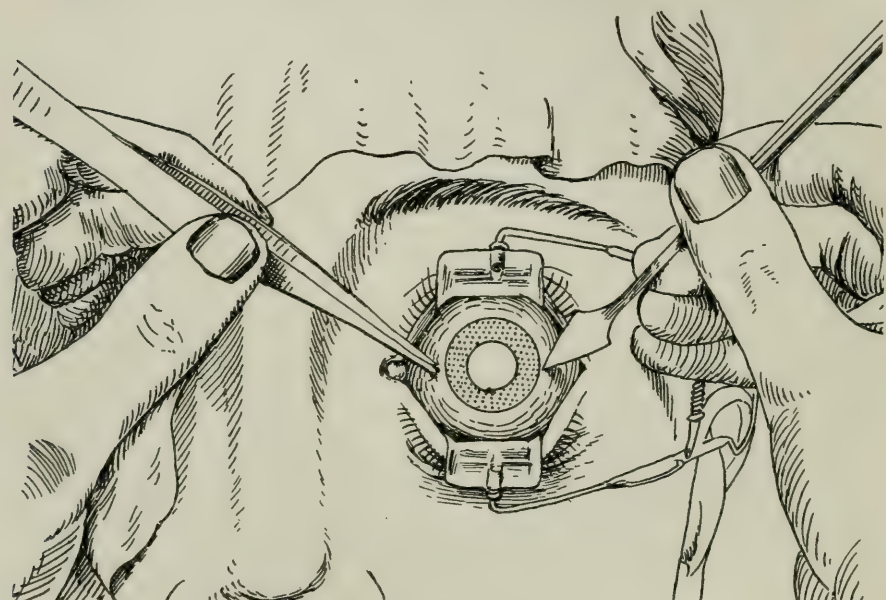
or at a point near the latter. Then the corneal incision is made. When operating upward, some operators prefer the Angelucci fixation, i. e., to grasp the conjunctiva and superior rectus for the purpose of holding the eyeball steady.



Lance-shaped Knives and How to Hold Them.

The incision may, of course, vary in width according to the individual case. Most operators prefer to make the corneal incision with a lance-shaped knife, either bent from the shaft at varying angles or straight. These knives are made of different widths to answer any size of incision which may be desired. The incision should be broad enough to allow of easy introduction of the iris forceps or iris hook.

Sometimes this is quite difficult of accomplishment, and every case must furnish its own rules for the guidance of the operator. When making the corneal incision with a lance-shaped knife, care must be taken not to produce a twisting motion of the eyeball, which might displace the point selected for the entrance of the knife. This accident may be obviated by keeping in view some landmark on the eye, as a bloodvessel, a spot in the iris, or, perhaps, a macula in the cornea. It is best in most cases to enter the point of the lance knife at the

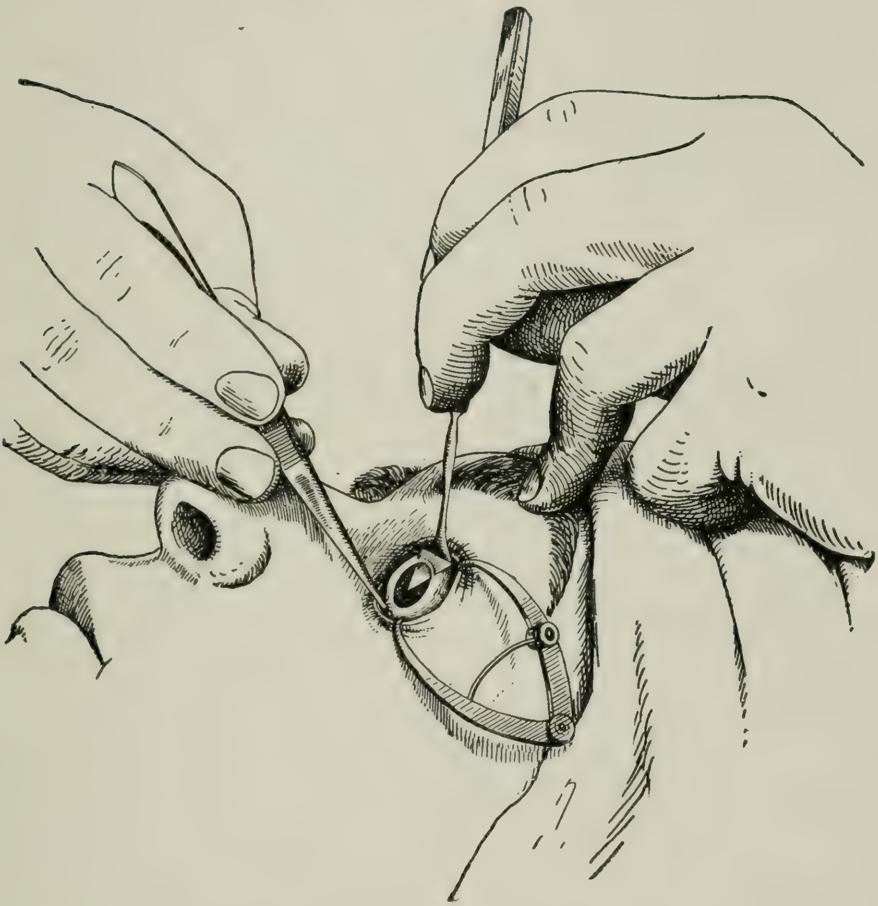


Incision with the Straight Lance Knife. (After Valude.)

limbus. The point should enter the corneo-scleral tissue and pierce it in the direction of the largest circle. This will help to make the wound canal shorter than if the knife were to pass through the cornea in any other direction. As soon as the point of the knife has penetrated the cornea and is seen to enter the anterior chamber, the handle of the knife is slightly depressed backwards so as to make sure that the point does not wound the iris. The knife is now gently and persistently pressed farther down into the anterior chamber in front and nearly parallel to the iris, until it has reached the desired depth and the corneal incision thereby the desired width. The operator during this maneuver must be careful not to wound either the posterior surface of the cornea with the point of the knife or the lens capsule

by pushing it too far into the chamber. The lance knife is then slowly and carefully withdrawn.

Wounding the lens capsule or iris during this act will be less likely to occur if the handle of the knife is depressed slightly, care being

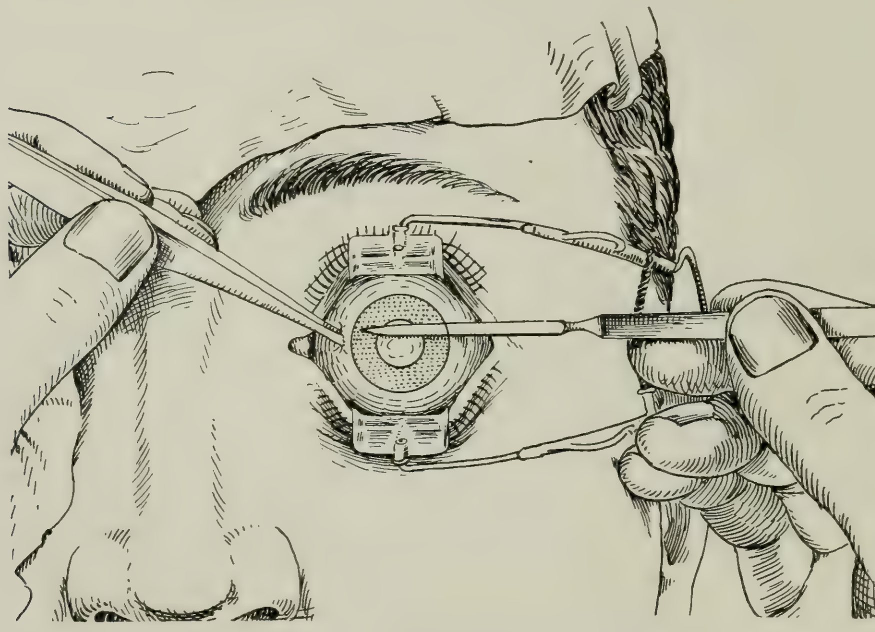


Incision with the Bent Lance Knife. (After Beard.)

taken at the same time that its point does not scrape the posterior surface of the cornea and so detach some of Descemet's endothelium.

The withdrawal of the knife should be made steadily and without haste so as to prevent too rapid outflow of aqueous humor. When, on account of the shape of the lance knife, the naturally smaller inner corneal incision is not large enough for the purpose of the operator, it may have to be enlarged, which can be done by a slight lateral

motion of the knife during its withdrawal. When local conditions are favorable the lance knife should be entered exactly at the corneal limbus, so as to avoid a possible hemorrhage from the conjunctival vessels which might enter the anterior chamber and obscure the field of operation. There can, however, be no hard and fast rule concerning this point, as the object of an optical iridectomy is to procure vision, and the artificial pupil must be placed where the best possible visual result can be obtained. The place of the corneal incision must therefore not infrequently be situated in the cornea itself, where it will serve the purpose best. In lamellar cataract, the location where the



Incision with the Graefe Knife. (After Valude.)

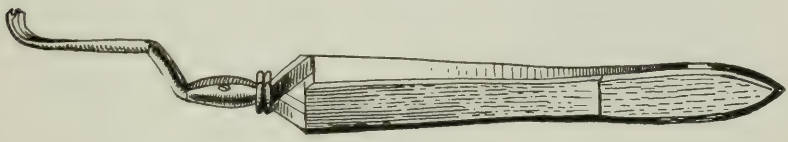
optical iridectomy is likely to give the best possible vision must be well determined before hand.

While many operators adhere to the use of the lance knife for the limbal incision in iridectomy, others, like the writer, prefer the narrow Graefe knife in most cases. The use of this knife in making the corneal incision, because of its narrow blade, is of decided advantage when the anterior chamber is shallow or partly obliterated; as, for instance, in cases of anterior synechia, tumor of the iris, etc.

Having entered the anterior chamber through the limbus or near it, the point of the Graefe knife is pushed through to the point of

counterpuncture, which has been previously selected, and the incision completed. When the anterior chamber is comparatively deep, this procedure offers no difficulty. When, however, the anterior chamber is very shallow, it will require a deft hand and some ingenuity to pass the knife between the posterior surface of the cornea and the anterior surface of the iris, to the place of counterpuncture without wounding the latter membrane. It is in such cases often necessary to make slightly undulating and sawing movements with the point of the knife so as to avoid elevated parts of the iris and to make use of the depressed ones, till the locality for the counterpuncture is reached.

Should the anterior chamber be so shallow as to render it impossible to pass even a Graefe knife between cornea and iris, it may be neces-



Mathieu Iris Forceps.

sary to make the corneal incision from without inwards, instead of in the ordinary manner just outlined. This can be done with a Graefe knife. Gayet (*Lancet*, Vol. II, 1875, p. 561) recommended a Desmarres scarificator for this procedure. The Graefe knife for this purpose was especially advocated by Burnett (*Am. Jour. of Ophthalmology*, April, 1902).

The corneal incision having been completed, the next step is to grasp the iris and draw it out through the corneal incision in order to cut out the desired piece of iris. This is done either by iris forceps, of which there are a great many models; or by means of a sharp, or better, a blunt hook, like Tyrrell's. The iris forceps must have thin but not too elastic, branches. The teeth with which they are armed at their ends are the only parts of the instrument that should grasp the iris. It is well, therefore, to examine the forceps carefully before the operation, regarding this point. In the common form of iris forceps the teeth are on the inner flat sides of the branches. When, however, the pupil is almost or totally occluded it is usually preferable to use a forceps, the branches of which make a rotary motion around the handle and have their teeth on the under side of the branches which stand nearly at right angles to the handle, as the Mathieu forceps. Most operators use forceps with curved ends, though some seem to prefer straight forceps. It is well, before operating, to see

that the teeth of the iris forceps do not lock, and that they open easily when the pressure is released. See **Forceps.**

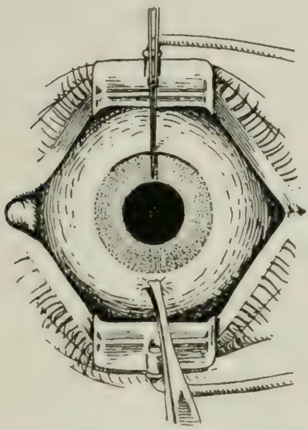
The iris forceps is entered through the corneal incision with its branches tightly closed, and carefully moved through the anterior chamber until its tip reaches the sphincter edge of the iris, which it is intended to grasp. The pressure on the iris forceps is now relaxed sufficiently to separate the teeth so as to include a fold of iris tissue between them, which, by again closing the forceps, is firmly grasped. The performance of this maneuver is dependent on well-made forceps, with teeth which easily come apart when the pressure is relaxed. Care must be taken not to grasp the iris in its entire thickness, else one may injure the anterior lens capsule. When well grasped the iris is gently pulled out through the corneal incision. Sometimes it is more advantageous to use a blunt hook, which is entered between the crystalline lens and the pupillary margin of the iris, so that the latter lies in the bend of the hook, and to draw the iris out in this manner. Such a hook must, of course, be absolutely smooth, so as guard against wounding the lens capsule. Even so, there is greater danger of such an occurrence than with iris forceps. On the other hand, the hook can be entered through a small incision, and in certain cases its use is more appropriate. It is best, too, to use a hook when making an iridectomy in an aphakic eye.

The corneal incision should be so placed that, whether small or large, the iris forceps can enter the anterior chamber at the middle of the incision in order to grasp whatever part of the iris is to be cut in the particular case in hand. This insures freedom of motion and the iris can then be drawn out in the best possible manner.

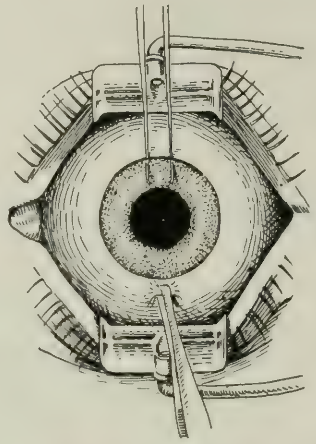
The piece of iris which it is desired to remove, having been drawn out through the incision, is cut off with iris scissors, of which there are many patterns. This is generally done by one, sometimes with two or even three, strokes of the scissors. Sometimes the iris, being incised on one end of the corneal incision, is then torn loose from its peripheral attachment across the corneal incision and the resulting iris flap cut off. This insures a peripheral iridectomy which is almost as broad as the corneal incision. In a general way it is best to keep in mind that the artificial pupil has a tendency to be larger than was intended, and to act accordingly. If it is intended to have the artificial pupil join the natural one, care must be taken that the sphincter edge is removed during the excision, otherwise there will be two pupils. Sometimes, when there are no posterior synechiæ, and in consequence of a too rapid outflow of the aqueous following the

withdrawal of the knife, a prolapse of the iris occurs. In this event the iris can be easily grasped and the iridectomy completed.

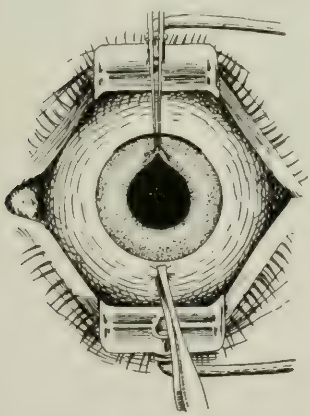
The iris scissors, of whatever pattern, should be held with the blades open, near the iris forceps, so as to be able to cut the piece of



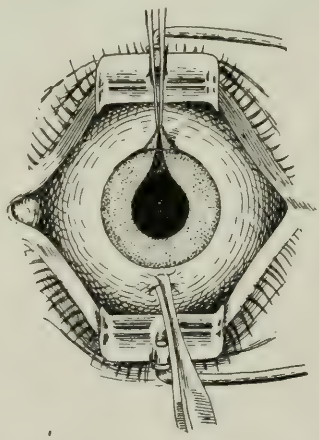
Introduction of the iris forceps.



Opening the iris forceps.



Grasping the iris.

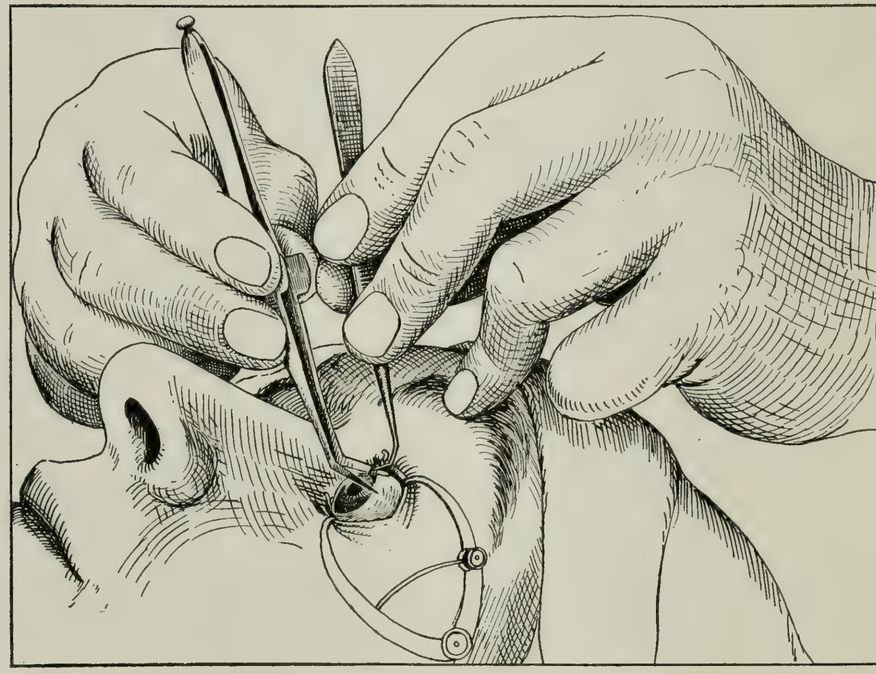


Drawing out the iris through the corneal incision. (After Valude.)

The Steps of an Iridectomy.

iris without delay. When it is desired to excise a large piece of iris, this is most easily accomplished by holding the blades of the scissors in line with the corneal incision; when, however, only a small artificial optical pupil is desirable, it can best be made by cutting the iris at right angles to the corneal incision.

Iris scissors are made with straight or curved blades; the curve may bend away from the cornea or be parallel with it but it should always be on the flat. In de Wecker's iris scissors (*pince ciseaux*) the short blades of which stand almost at right angles to the shaft and turn around this when pressure is exerted to close them, are often of particular value and are the only ones used by some operators. See, also, **After-cataract.**



Steps of an Iridectomy.
Cutting Off the Iris with *Pince-ciseaux.* (After Beard.)

After the excision of the iris the limbs of the resulting coloboma may of themselves return into the anterior chamber. Frequently, however, some part is caught and held between the corneal wound lips, especially the angles of the incision. In most cases the imprisoned portions can be freed by means of a narrow spatula and can be gently pushed back into their proper position. This may be aided by gently stroking the cornea over the incision. In some cases it may become necessary to enter the wound lips again with iris forceps, draw the caught portion out, and cut it off. During these different manipulations especial care must be taken not to wound the lens capsule or to tear the zonule of Zinn.

In rare cases it may be desirable not to cut the sphincter edge of the iris, as, for instance, when a very small pupil and one lying exactly behind a certain clear space in the cornea is desired. This method was introduced by Pope in 1871 (*Arch. f. Augenheilk.*, Vol. II, p. 192). It was rediscovered by Salva (*Le Dauphiné medical,* Aug., 1900, p. 169). Kühnt (*Tagebl. der 58ten, Versammlung deutscher Naturforscher und Aerzte.*, 1885, p. 497) has devised an adjustable iris forceps for it. This method has been adopted by some operators as the routine procedure when making a combined cataract extraction.

A number of unfortunate *accidents* may occur during the making of an iridectomy. It may happen that the point of the lance knife (rarely, however, of the von Graefe knife) does not pierce the whole thickness of the cornea during the incision, and in pushing the knife forward the cornea is for some distance split into two unequal parts, more or less parallel to its surface. The fact that no aqueous humor escapes will make the operator aware of this accident. The knife must then be withdrawn and another attempt made. Such an accident may defeat the object of the iridectomy, on account of the resulting scar, especially if the clear space in the cornea which is to be utilized for subsequent vision is very small. In other cases the corneal incision may be too small. This may result from faulty direction of the knife, and generally from making the inner wound opening considerably smaller than the outer one. Such an accident cannot happen with a Graefe knife. When an incision is too small for the entrance and opening of ordinary iris forceps, a Mathieu forceps may be used with success. It may, however, become necessary to enlarge the inner wound with blunt-pointed scissors or with a blunt-pointed lance knife. If the operator is aware of the condition, as he should be, before withdrawing the lance knife, he can enlarge the inner wound by making lateral motions with the knife while withdrawing it.

The point of the lance knife may become entangled in the iris tissue if the handle is not depressed at once after the point has passed through the cornea into the anterior chamber and the blade is not brought into a position parallel to the iris surface. Not only may the iris be wounded by this procedure but the crystalline lens may be injured, or the zonule of Zinn torn. As the knife is pushed farther down, the iris may be dragged along with it or it may even be torn off at its periphery. Should this occur the knife should be carefully withdrawn with as little loss of aqueous humor as possible. Wounding the lens leads, of course, to the formation of a cataract, and, if the zonule of Zinn is torn the lens becomes dislocated, and there may even

result a prolapse of vitreous. Similar accidents are less likely to happen when the incision is made with a Graefe knife.

If, in making the corneal incision, a slight twisting of the knife blade separates the wound-lips, the aqueous humor may escape, and thus make it very difficult to enter the knife farther into the resulting shallow anterior chamber. This accident is less likely to happen with a lance-knife than with a Graefe knife. The occurrence is then of rather serious importance, since the iris is usually caught upon the sharp edge of the knife and cut through during the completion of the incision. Thus the purpose of making a clean iridectomy may be defeated.

The aqueous humor should not be allowed to flow out too rapidly, as this might cause serious complications. The most frequent one is prolapse of the iris. If accompanied by no further untoward results, prolapse of the iris is not a serious accident. It is, indeed, courted by some operators who prefer to grasp the iris outside of the eye. The considerations formerly justifying such a custom, however, no longer seem to exist in these days of asepsis. Prolapse of the iris may also be associated with a rupture of the zonule of Zinn, dislocation of the lens, and prolapse of the vitreous body. In rare cases, too rapid outflow of the aqueous humor has led to hemorrhage from the choroidal bloodvessels, expulsive hemorrhage, so called, and destruction of the eye.

As a rule, no hemorrhage occurs from the cut edges of the iris, even if it is diseased. Yet, when the walls of its bloodvessels are degenerated hemorrhage from the iris may occur as soon as the corneal incision is completed and the aqueous humor has flown out, even though the iris has not been wounded by the knife. Such a hemorrhage, though slight, will generally obscure the operative field. In most cases the blood fills the anterior chamber very quickly and renders the iris invisible. To remove this blood from the anterior chamber is not an easy task because it so rapidly coagulates. The best method is to press out the blood by means of a spatula or similar smooth instrument, gently into the corneal incision where it may be soaked up by pledgets of sterile cotton. If this is successfully accomplished the operation can be completed. It is not necessary to remove all the blood out of the anterior chamber, as what is left is generally absorbed in the next few days.

Should the iris be grasped with too much force or be pulled out with unnecessary vigor, it may be torn from its ciliary attachment. It may even be torn out of the eye in its entirety by an awkward

operator. The danger of such an occurrence is decidedly reduced in our day, since the introduction of local anesthetics.

See **Iris snipper**; also **Iridodialysis** and **Glaucoma.**

In rare cases, after an iridectomy has been faultlessly performed, it is found that the vision has not been improved. An inspection of the eye may disclose the fact that the pigmented epithelial layers of the posterior iris surface have remained glued to the anterior lens capsule, and only the stroma of the iris has been removed. In such cases removal of the crystalline lens may remedy the condition.

The healing process after an iridectomy has been performed, is usually uneventful. The lips of the corneal wound are readily and firmly united, and the anterior chamber soon becomes refilled with aqueous humor. The complete healing of the corneal wound would require, as the writer has shown, from 18 to 21 days (see Alt, *Arch. f. Augen und Ohrenhlk.*, 1875), but as a rule, the bandage may be removed after one week. Some discussion has taken place in regard to the healing of the wound of the iris stump. Certain authors, notably Henderson (*Ophthalmic Review*, May and June, 1907), claim that iris wounds never heal, and thus explain the lowering of the intraocular tension by means of an iridectomy. The writer (*Arch. of Ophth.*, Vol. IV, p. 473, 1875; and *Journal of the A. M. A.*, July, 1911), from experimental researches and the study of numerous eyes after iridectomy, is convinced that in most cases the stump heals firmly.

The healing of the corneal wound may be delayed and a continued leakage of aqueous humor result, conditions that prevent the re-establishment of the anterior chamber. This may be due to a lack of vitality of the corneal tissues, but, as a rule, it is caused by the interposition of some minute parts of iris, conjunctiva or, perhaps, of lens capsule between the wound lips. In cases of this sort this foreign material should be removed, and the eye firmly bandaged for a number of days.

Hemorrhages into the anterior chamber sometimes occur a day or two after the iridectomy has been performed. They seldom fill the whole anterior chamber. The blood is usually absorbed after a very few days.

The closed but not yet firmly healed corneal incision may sometimes be ruptured in consequence of a quick movement of the patient, or by sneezing or coughing, or even from pressure against the pillow, or by the hand, during sleep. Usually a renewal of the bandage will suffice to overcome this. In other cases some prolapsed tissue may prevent prompt healing of the wound, and it should be removed.

Unless infection has taken place, such an accident is usually of no great importance.

Infection of the corneal wound after iridectomy was of very rare occurrence even in pre-aseptic times, and it is even more unlikely to happen nowadays. When infection does occur it usually makes itself known on or after the third day, by pain, swelling of the lids, especially of the upper one, by purulent discharge which adheres to the eyelashes, and by some muco-purulent floccules in the conjunctival sac. The conjunctiva is edematous and the corneal wound lips appear grayish or grayish-yellow. Eyes thus infected are usually lost in spite of vigorous treatment, which consists chiefly in cauterization of the wound lips, followed by the insufflation or introduction of one of the impalpable antiseptic powders, like xeroform; and hot applications. Infections of iridectomy wounds occurring later generally are of a much milder character, causing merely a plastic iritis; in rarer cases a purulent iritis results.

To prevent infection of the corneal wound lips Ellett (*Ophth. Record*, April, 1903) proposes to cover the whole cornea with conjunctiva. He dissects the conjunctiva free from the corneal periphery, and for a distance backwards sufficient to pull the loosened conjunctiva over the cornea. He then unites the conjunctival edges by a horizontal row of stitches. On the fourth day the stitches are removed and the conjunctiva glides back into its normal position.

In the *"combined" cataract extraction,* as distinguished from "simple" extractions, the iridectomy is an important step of the operation. While in general the manner in which it is performed to best advantage has been described in the foregoing (see, also, under **Cataract, Senile**) it should be mentioned that, following Mooren's (of Düsseldorf) example, a considerable number of operators prefer now to make a "preliminary" iridectomy several weeks or months before completing the cataract extraction. Although this forces the patient, who may be very old and feeble, to virtually undergo two operations, as well as to lose considerable valuable time, yet this method is advocated, because of the smaller danger from infection and from iritis; it is also, undoubtedly, easier by this method to deliver the lens. Such iridectomies are usually made comparatively small and not up to the periphery of the iris; indeed, some operators like Woelfflin, Pflueger, Chandler and Snellen recommend a peripheral iridectomy, leaving the sphincter intact.

Therapeutic iridectomy, that is an operation made for the purpose of curing certain diseases of the eye, has its greatest field of usefulness in glaucoma. The discovery of A. von Graefe that an iridectomy

reduces intraocular pressure has been a great boon to those afflicted with glaucoma, and, in spite of the numerous substitutes introduced of late, iridectomy is still the most trustworthy operation, especially in acute inflammatory glaucoma and in some cases of secondary glaucoma. Even in the newer operations for glaucoma, an iridectomy is usually combined with the special feature of the individual operation.

Having proven the beneficial action of iridectomy in glaucoma, von Graefe recommended this operation in still other diseased conditions of the eye, where a curative result might be expected by a reduction of the intraocular tension, even if it was normal. Similar results had formerly been obtained by tapping the anterior chamber. This latter operation must, however, be repeated many times before a definite result is obtained. On the other hand, the result obtained by an iridectomy is apt to be permanent.

The curative influence is, perhaps, especially evident in cases of *partial staphyloma,* or in cases of *corneal ulcer threatening perforation.* Its beneficial effect in these latter cases has been almost forgotten since Saemisch's incision, cauterization and serotherapy have come into use. De Wecker (*Traité des Maladies des Yeux,* 1887) at first strongly recommended an iridectomy even in hypopyon keratitis, but later abandoned it. Later, Bettremieux (*Jour. d'oculistique du Nord de France,* Vol. V, No. 3, November, 1893) again advocated it particularly on account of its antiphlogistic and curative influence. He tried to prevent a peripheral ulcer from invading the center of the cornea and when possible made the iridectomy upwards.

A number of operators, like Bronner (*Brit. Med. Jour.,* December 10th, 1908) believe in making an iridectomy even in a recent iritis. The general opinion, however, seems to be not to make an iridectomy as long as signs of inflammation are present, since, as a rule, such colobomata are very quickly closed again. According to the experience of most operators, also, an iridectomy should not be performed in cases of chronic iridochoroiditis, nor in sympathetic ophthalmia until all signs of inflammation have been absent for some time. In relapsing iritis the value of an iridectomy seems to be nil.

While in general no iridectomy should be done on a very soft eye, it has been advocated as serving a useful purpose in detachment of the retina (Fano, 1869). Improvement following this operation has been reported by a number of authors; Dransart even claimed a cure in 11 out of 16 cases. It seems very doubtful, however, whether any lasting good can follow this operation in such a condition.

In rare cases, fortunately, the iris is the seat of a tumor. Such tumors when solid are, as a rule, sarcomata. Semi-solid growths are

cystic in nature, generally dermoid implantation cysts filled with sebaceous material. Serous cysts are characterized by thin, semi-transparent walls. Sarcomatous tumors, of course, endanger the life of the patient, while cystic tumors at least endanger the eye itself. It is, therefore, imperative in most of these cases to remove the tumor as early as possible. This may be accomplished by an iridectomy which includes the tumor and reaches somewhat farther into the healthy iris tissue. If the tumor lies near the pupillary margin this may be successfully done, particularly if the tumor is not adherent to Descemet's membrane. Small sarcomata of the iris have been removed in this way and the patients were apparently cured. The sarcoma cells in these instances had not yet been carried away from their primary seat. In many cases, however, relapses and metastases have been observed (Wood and Pusey *Arch. of Ophth.,* 1902) and it is, perhaps, better not to depend too much upon a therapeutic iridectomy in these cases, but rather to enucleate the eyeball at once.

When a cystic tumor is adherent to the posterior surface of the cornea, its removal, if partial only, offers disagreeable obstacles, and an iridectomy including the tumor can seldom be accomplished.

In order to reduce the size of a serous cyst so that it can finally be removed by an iridectomy, Messner has proposed to tap the cyst several times, until it is sufficiently reduced in size to render possible its perfect removal by iridectomy.

In rare cases a foreign body in the iris, especially when of a non-magnetizable metal, will require an iridectomy for its removal. This is comparatively easy, unless the foreign body lies in the iris angle. In this case it can only be removed by iridectomy after it has been carefully pushed out of the iris angle and nearer the sphincter margin with a sharp needle. When this has been successfully accomplished the removal, together with a piece of iris, is comparatively easy.—(A. A.) See, also, other relevant headings in this *Encyclopedia.*

Iridectomy, Diametric. See **Diametric iridectomy**; as well as **Diametric pupil.**

Iridectropium. (L.) Eversion of a portion of the iris.

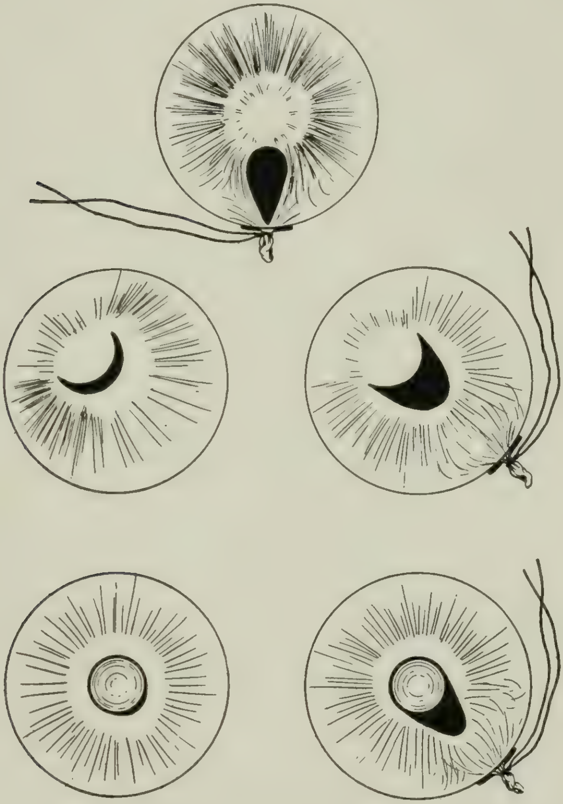
Iridelcosis. (L.) An old term for ulceration of the iris.

Iridemia. Hemorrhage from the iris.

Iridencleisis. Iridencleismus. Iridesis. Iridotasis. Iridenkleisis. An operation for artificial pupil, devised by Adams, in 1812, and by Himly, in 1816, which consists practically in displacement of the pupil.

Later on Critchett (*Trans. Ophth. Soc. of the United Kingdom,* 1892) revised the operation. He made a small section at the corneal limbus corresponding to the site of the most transparent part. This

opening was to be no larger than just to be able to grasp the iris through it with forceps. The iris, seized midway between its periphery and the pupillary edge, was slowly drawn out and tied with a fine silk thread, the long ends of the thread being left hanging outside so as to prevent the slipping back of the iris. In this manner a small pupil could be placed in the most desirable and most useful



Critchett's Iridenkleisis. (After Valude.)

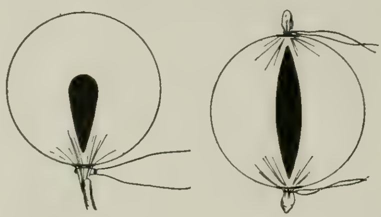
position. After 48 hours the thread and iris tissue outside the wound fall off.

De Wecker and Stellwag in making this operation discarded the ligature and simply caused an artificial prolapse to become incarcerated in the corneal wound, and cut this prolapse off later on.

Bowman (*Ophth. Hosp. Rep.*, 1860, p. 154) by making two iridenkleises opposite each other, tried to procure a pupil forming a stenopeic slit in cases of keratoconus.

Iridenkleisis may become necessary in certain cases of traumatic iridodialysis. The writer has several times performed this operation when iridodialysis was sufficiently large to worry the patient continually, not on account of the two pupils, but because of the partial immobility of the pupil and because the iris would dangle about with the movements of the eye. By causing the periphery of the iris to become incarcerated in a scleral incision, that is, making an iridenkleisis, the unsightliness of the eye and the subjective discomfort of the patient were removed.

Jameson (*Arch. of Ophth.*, XXXVIII, 1904, p. 391) in cases of traumatic iridodialysis tried to bring about a union of the iris periphery with a freshened surface within the anterior chamber without incarceration of the iris in the corneal wound. Only the histological



Bowman's Double Iridenkleisis for Keratoconus (after Valude).

examination of such an eye will show whether he has succeeded in reaching his aim or not.

The first step in his operation is the introduction of 2 sutures 3 mms. back of the sclero-corneal margin into the anterior chamber where they are to pick up the torn iris periphery, less than 1 mm. from the torn edge. Then the needle is brought out through iris and cornea at the same time, and the needles are removed. Now a linear corneal incision is made in a straight line between the site of the two sutures, stopping at each end a short distance from where the needles were entered. Then a blunt hook being introduced, the parts of the threads which have pierced the iris and cornea are pulled back, out of the cornea and out of the eye. Each thread is then tied. Jameson says: "The sutures when tied bring the iris in contact with the inside of the linear incision and to the points of the primary perforation of the needles, but not between the lips of the incision." He uses horse-hair or silkworm gut for the sutures.—(A. A.).

See, also, **Iridesis**; **Iridotasis** (Borthen's operation); and **Glaucoma.**

Iridencleismus. See **Iridencleisis.**

Iridentropium. Inversion of the iris.

Irideremia. The tearing away of the whole or almost all of the iris from its attachment is almost invariably due to injury, and is gen-

erally the result of a traumatism that produces rupture of the cornea and prolapse of the iris.

Congenital aniridia or irideremia is described under **Congenital anomalies,** while the traumatic form is fully described under the caption **Injuries of the eye.**

Iridescence. This term is commonly applied to the sheen of mother-of-pearl and other objects possessing a finely grooved surface. It is due to interference between the waves of white light reflected from different levels in the grooving; some of the wave-lengths are more completely abolished by interference than others are; the result is that the residual vibration which reaches the eye contains a preponderant proportion of the rays which have been less affected by interference, and the reflected light accordingly presents colors which vary according to the angle of reflection.

Iridescent vision. A state of vision in which all the objects viewed appear either colored, or with their outlines surrounded by prismatic colors, as, for instance, in glaucoma and some forms of cataract.

Iridesemia. (Obs.) Partial or complete absence of the iris.

Iridesis. IRIDDESIS. IRIDODESIS. An operation devised by Bowman and much used by the elder Critchett for making an artificial open-

Critchett's Iridesis Needle.

ing by incarceration of the margin of the iris in a peripheral corneal wound. The knife-needle he used for the purpose is depicted in the text. See Donders' *Accommodation of the Eye*, pp. 511 and 552. See also, **Glaucoma**; as well as **Iridenkleisis**; and **Iridotasis.**

Iridial. IRIDIAN. Pertaining to the iris.

Iridic. Pertaining to the iris.

Iridien. (F.) Iridian; iridal; of the iris.

Iridine. Iridescent; gleaming with a metallic lustre.

Iridique. (F.) Iridal; iridian; pertaining to the iris.

Iridisation. IRISATION. Conducing or pertaining to iridescent color.

Iriditis. (L.) Thought by some to be a more correct form of *iritis.*

Iridoallochrosis. IRIDALLOCHROSIS. (Obs.) A change in the color of the iris.

Iridoavulsion. IRIDAVULSION. Complete tearing away of the iris from its periphery. It is sometimes resorted to as a treatment of glaucoma. See **Irideremia.**

Iridocapsulectomy. This term is applied by Bourgeois (*Archives d'Ophtalm.*, May, 1911) to an operation for *thick, secondary cataract with adherent iris.* In cases of seclusio pupillæ after cataract extraction it is necessary to obtain as large an artificial pupil as possible, in order to avoid any chance of the pupil reclosing. To effect this, three layers must be cut through, namely, the iris, remains of exudate and pigment, and remains of lens or thickened capsule, and a portion removed.

The author uses a bent broad-needle, a blunt Tyrell's hook made of silver and slightly bent at its extremity, and a pair of de Wecker's iridectomy scissors.

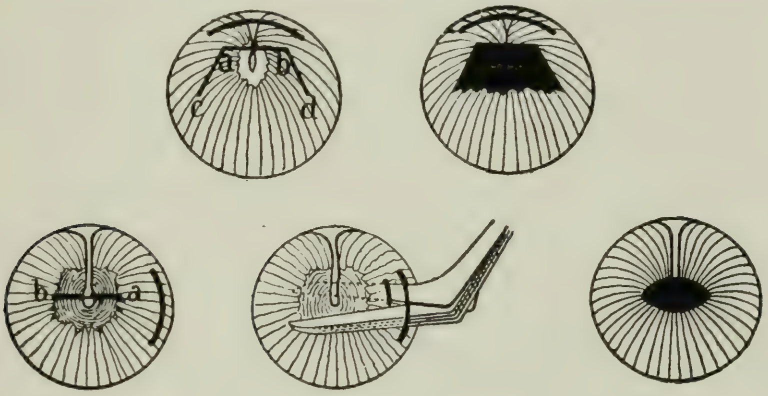
The eye is fixed in its upper part and an incision made with the broad-needle in the cornea, 3 or 4 mm. from its lower border. The incision is, of course, subject to variations according to the position in which it is desired to obtain the artificial pupil. The point of the needle is directed upwards and then made to puncture the irido-capsulary membrane as high as may be desired. During withdrawal, the corneal incision is increased laterally by the sharp edges of the needle, the average incision being about 5 mm. The Tyrell's hook is next introduced on the flat, and the lower edge of the irido-capsulary membrane drawn through the corneal incision, as much as may be necessary is snipped off by de Wecker's scissors, and the operation is complete. The use of a repositor is usually necessary. See, also, p. 132, Vol. I of this *Encyclopedia*, also **Iridotomy**; as well as under **Cataract, Secondary.**

Iridocapsulitis. (Obs.) Inflammation of the iris and the capsule of the lens.

Iridocapsulotomy. Although this operation has been referred to under **After-cataract** and elsewhere yet it seems desirable to describe the operation more fully in this place.

Its object is the creation of an artificial pupil without incision of the iris. The necessary instruments are speculum, fixation forceps, keratome, one narrow von Graefe knife, and the pince-ciseaux of de Wecker, of which one blade is sharp and the other blunt. The speculum being in position and the eyeball fixed, the surgeon passes the keratome through the cornea at a point one millimetre from the corneal limbus. The exact location of the corneal incision will depend upon the direction in which the thickened iris and lens-capsule are drawn. If the condition demanding this operation has followed a cataract operation, in which the upper corneal section was made, the keratotomy for the operation of irido-capsulotomy will be placed at the temporal end of the horizontal diameter of the cornea. The

keratome is quickly withdrawn and the pince-ciseaux, with blades closed, is passed into the anterior chamber. The sharp blade is made to pierce the iris and lens-capsule, at a point two or three millimetres within the limbus. The instrument having been passed toward the nasal side, the blades are quickly closed, thus cutting the obstructing tissues (see the figures), which, if elastic, will retract and thus leave the desired pupillary opening. There are several modifications of this operation. If the pupil is drawn far upward, or is concealed by the corneal cicatrix, the operation, represented in one of the cuts, will be valuable. A keratome is passed through the cornea and also through the iris, making an iridal incision (a-b) three or four millimetres in length. At each extremity of this incision a cut (a-c; b-d) is



Iridocapsulotomy. (De Wecker.)

made with the pince-ciseaux. If the tissues are elastic, a large pupillary opening will result. If the tissues do not retract, the procedure must be changed into an iridocystectomy.

Iridocele. (L.) Prolapse of the iris through a perforating wound or ulcer in the cornea.

Iridoceratitis. A spelling of *iridokeratitis;* inflammation of the iris and cornea.

Iridochorioid. See **Iridochoroid** headings. The official spelling is CHOROID, *not* CHORIOID.

Iridochoroidal. Pertaining to the iris and to the choroid.

Iridochoroiditis. IRIDOCHOROIDITIS IN GENERAL. Inflammation of the iris and the choroid. During an attack of iritis other tissues of the eye generally suffer with the iris. In the suppurative forms of choroiditis there is always an accompanying iritis; and in many forms of exudative choroiditis iritis may be present. The various forms of

the composite disease are described under separate captions and, as well, are included under **Iritis** and **Choroiditis** headings, especially on p. 2144, Vol. III of this *Encyclopedia.*

Iridochoroiditis, Consecutive. Iridochoroiditis secondary to iritis. See **Choroiditis in general,** Vol. III, p. 2144, of this *Encyclopedia.*

Iridochoroiditis, Gonorrheal. Cases of inflammation of the uveal tract which follow or are associated with gonorrheal arthritis, have been described by Bull. Among the ocular symptoms are great reduction in visual acuity, pain, photophobia and lacrimation. Ciliary injection, exudation into the anterior and the vitreous chambers, and increase of intra ocular tension are also noted. Vision, which may be reduced to light perfection, improves rapidly after the administration of anti-rheumatic remedies. See, also, **Iritis.**

Iridochoroiditis plastica. The usual form of iridochoroiditis, characterized by circumcorneal injection, sensitiveness to pressure, discoloration and sluggishness of the iris, cloudiness of the aqueous humor, opacities in the vitreous, either fixed or floating, and marked failure of vision.

Villard (*Arch. d'Opht.*, Vol. XXX, 1911) reports two cases, which he believes are the first on record, where a plastic iridochoroiditis followed a very severe gastroenteritis in children, one four months and the other three years old. The lesion was an insidious one, and occurred when the other condition was gravest. See, also, **Choroiditis in general,** Vol. III, page 2144 of this *Encyclopedia.*

Iridochoroiditis, Recidivirende. (G.) Recurring iridochoroiditis.

Iridochoroiditis serosa. The form in which the effusion is almost entirely serous, causing increased tension and a haziness of the vitreous and occasionally of the aqueous humor. See **Choroiditis in general,** Vol. III, p. 2144, of this *Encyclopedia.*

Iridochoroiditis suppurativa. A form of the disease characterized chiefly by the rapid appearance and disappearance of a hypopion, derived from the ciliary body. There is but little irritation or injection, and the aqueous humor is only slightly cloudy. This variety of iridochoroiditis does not differ in its symptoms or course from other forms, except in the character of the exudation. See, also, **Choroiditis in general,** Vol. III, p. 2144, of this *Encyclopedia.*

Iridochoroiditis sympathica. Iridochoroiditis in sympathetic ophthalmitis.

Iridochoroiditis traumatica. Iridochoroiditis from injury. See **Injuries of the eye.**

Iridocinesis. (Obs.) IRIDOKINESIA. Contraction and expansion of the iris, either normal or pathologic, as in *hippus.*

Iridocoloboma. The part of the iris removed in iridectomy. Coloboma of the iris refers to a congenital fissure in the iris due to arrest of development. See **Coloboma, Iris**; as well as **Congenital anomalies.**

Iridoconstrictor. Any one of the short ciliary elements of the iris.

Iridocorneal angle. The angle of the anterior chamber, or point of junction of the iris, cornea, sclera, and ciliary muscle forms an important part of the eye, both anatomically and pathologically. See **Glaucoma**; also **Histology of the eye,** and p. 3523, Vol. V, of this *Encyclopedia.*

Iridocyclectomy. Surgical removal of the iris and of the ciliary body.

Iridocyclitis. Iridocyclitis in general. Inflammation of the ciliary body is always accompanied by changes more or less extensive in the iris, and this condition may properly be considered under the term iridocyclitis.

Three clinical forms of iridocyclitis are generally distinguished: (1) a mild form, which may be termed serofibrinous (serous cyclitis); (2) plastic iridocyclitis; and (3) purulent iridocyclitis.

Traumatic iridocyclitis. All forms of injuries to the ciliary region may give rise to iridocyclitis, but of special importance and frequency are perforating wounds of the limbus and foreign bodies within the globe. An originally purulent process seldom changes to the plastic type, but such a change is seen in corneal suppuration and in late infection through cicatrices and iris prolapse. Such injured eyes may lead to sympathetic irritation or inflammation in the fellow eye.

The irritation or inflammation may be due to a mechanical injury to the tissues, as seen in iridocyclitis following lens luxation. This was the ultimate end of cataractous eyes operated upon by reclination in previous centuries.

Again, it may be a chemical irritation, as from retained iron or copper foreign bodies. The latter may remain in place for months or years and then cause inflammation from further laceration due to movement of the object, or pulling away of tissues from contraction of a plastic exudate, or to chemical irritation through solution.

The production of irritation or inflammation may be due to germs themselves or the products of their metabolism, a subject which is discussed under **Sympathetic ophthalmia.** While we have not yet isolated such micro-organisms, various authors have supposed that the germs may lie dormant for months or years and then acquire a new virulence, setting up inflammation.

Endogenous infection of the cicatrix has also been postulated, and late infection of the scars has been proven.

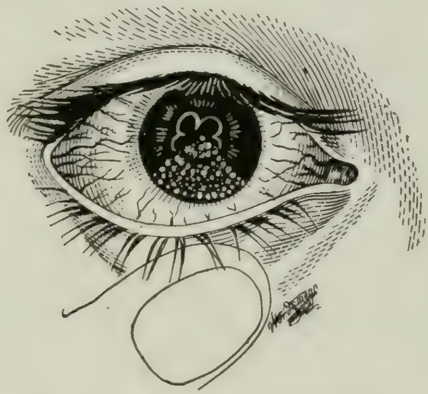
Cramer (*Klin. Monats. f. Augenh.,* January, 1911) observed a large

number of instances of mild iridocyclitis following endemic, infectious intestinal catarrh. Galezowski and Berche (*Rev. d'Opht.*, XXXIII, p. 97) reported five cases of iridocyclitis which occurred soon after bilateral removal of the ovaries; the cases are analogous to similar conditions known to occur in menstrual disturbances and the menopause. The favorable action of ovarian extract upon the progress of the cases also points to the causal connection with the operation. The extract checked the progress and brought about amelioration; relapse followed abandonment of the remedy. Two of the cases which were not treated by organo-therapy ended in blindness. Walker (*Ophth. Rec.*, XX, p. 32, 1911) described a case of iridocyclitis following a gumma of the anterior surface of the iris which had absorbed in three weeks after the use of mercurial inunctions. Black (*Ophth. Rec.*, XXII, 1913) reported a case chronic iridocyclitis, the result of a penetrating wound of the eyeball by a piece of wire. The iris was injured and extraction of the cataractous lens had been performed. In a case of diffuse, epibulbar carcinoma, McBurney (*Klin. Monatsbl. f. Augenh.* Vol. 53, p. 106, 1913) noted the occurrence of iridocyclitis with anterior and posterior synechiæ, infiltration of the choroid and endophthalmitis. Mlady (*Woch. f. Therap. u. Hyg. d. Auges*, Vol. 17, 1913) reports a case of recurring "rheumatic iridocyclitis." In this connection it is of interest to note that Zentmayer (*Amer. Jour. Ophth.*, Vol. 31, p. 58, 1913) points out that since the more restricted use of the term "rheumatism," the number of cases of rheumatic iritis has diminished.

After cataract extraction, even where the operation has been done well, iridocyclitis may develop about the tenth day. In this form of complication there will be noticed a zone of circumcorneal injection; the pupil may be round and the iris movable; vision may be good; pain, especially at night, may ensue. The capsule of the lens becomes thickened and vision is reduced. The process may subside without leaving any bad results, or it may increase and terminate in glaucoma. Cobbledick (*Ophthalmoscope*, December, 1912) maintains that *acute* cases of iridocyclitis which in the past have been classed as "rheumatic," are mostly, if not all, gonorrheal in origin, and the gonococcus is by far the most common cause of *acute* iridocyclitis. The gonococcus is never found in the aqueous. Byers, from a pathologic examination of an eye with gonorrheal iridocyclitis, concludes that the inflammation is the result of a toxin. If so it should be feasible to prevent recurrence by curing the urethral discharge, and it is the ophthalmic surgeon's duty to urge the importance of special treatment for the urethral discharge in order to lessen the possibility of

recurrence of the eye trouble. The presence of gonococci in the urethra and its diverticula is so constant in these cases of iridocyclitis, that they must be looked upon as the cause.

Serofibrinous iridocyclitis (serous cyclitis) is most frequently caused by traumatism of the ciliary processes. A discission of cataract is frequently attended with undue traction on the ciliary processes. A hyperemic condition of the ciliary body is thus induced, and at the end of twenty-four to forty-eight hours ciliary tenderness develops. There is often slight ciliary injection and some serofibrinous exudation.



Keratitis Punctata. (Würdemann.)

Keratitis punctata is the chief sign of *serous cyclitis* and *serofibrinous iridocyclitis*. It is characterized by precipitates appearing as minute greyish dots scattered irregularly upon Descemet's membrane, but mostly irregularly over a triangular portion of the lower part, the base of the triangle corresponding to the lower corneal margin, the apex to about the center of the cornea. The larger deposits are usually below, the more numerous fine ones above. The spots are frequently pigmented, looking brown or reddish. The movements of the eyes are a factor in determining their arrangement, being deposited centrifugally upon the cornea, and in the positions in which they occur the endothelium of Descemet's membrane is irritated and becomes sticky, so that leucocytes readily adhere to it. Larger aggregations occur in older cases and often assume a yellowish, gelatinous appearance. They consist in aggregations of leucocytes, many of which contain pigment granules that are derived from the uveal tract, mostly from the ciliary body. Proliferation of endothelium may occur. The larger deposits show a hyaline degeneration of the cells. These deposits may likewise be found upon the lens capsule.

Plastic iridocyclitis ordinarily develops rather insidiously in from two to five days after an injury or an operation on the crystalline lens. There is ciliary injection, often chemosis, increased lacrimation, photophobia, slight discoloration and cloudiness of the iris, plastic exudation with proportionate decrease of vision, edema of the margin of the upper lid which may extend to the entire lid, and pain referable to the eye, the forehead, and temple. The pain is most marked at night. The severity of the symptoms increases for three or four days, the pain sometimes becoming excruciating. The plastic exudate is poured into the posterior chamber, filling the pupillary area, blocking up the pupil, and forming adhesions between the iris and the capsule of the crystalline lens.

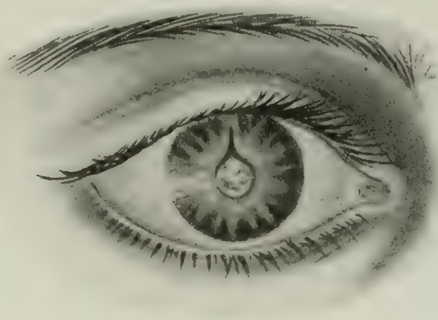
Panel-like Keratitis. (Würdemann.)

As the case progresses the cornea becomes grayish and may be striped (panel-like). Then follows development of a large fibroplastic exudate in the pupil, between its edges, between the iris and lens, ciliary body and lens, and in the vitreous. The visual acuity is lost, the light projection becomes more and more uncertain and blindness results. If the pupil fills up with exudate the condition is known as *occlusion;* if a complete posterior synechia forms, as *seclusion;* if only the rim of the iris adheres to the anterior capsule of the lens, the pupil is secluded but the posterior chamber is enlarged from the iris bulging forwards in a ring. This condition is known as *iris bombé*. See **Bombé iris.**

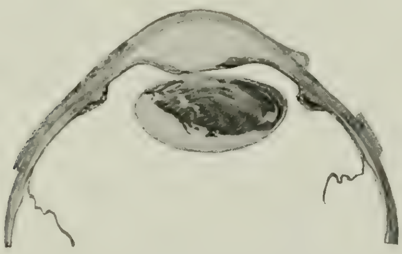
The lens becomes contracted and cataractous. The ciliary body may be detached in part from its scleral insertion. The choroid and retina may also be detached anteriorly by the traction exerted by the shrinking exudate. The tension of the globe is usually reduced and may reach T—3; but during the early stages temporary increase of tension may occur. Chemosis may develop and it may continue for a long time, in some cases even becoming permanent. Ciliary injection

remains for some weeks. The edema of the margin of the upper lid passes away in three days to as many weeks. The active process may subside in two weeks, but frequently it lasts a much longer time; recurrences are common. The changes that follow the acute or active stage continue for months and years.

Purulent iridocyclitis is induced by the entrance into the anterior segment of the globe, usually by perforating injury, of pathogenic



Iris Bombé from Sympathetic Iridocyclitis. (Würdemann.)



Section of Eye with Iridocyclitis Showing Iris Bombé. (Würdemann.)

microöganisms of sufficient virulence and in sufficient quantity to establish the disease. Vision is usually destroyed in this form of iridocyclitis and *phthisis bulbi* results.

The question of the possible *origin of chronic iridocyclitis in focal infection* was discussed at a meeting of the British Medical Association (*Lancet*, August 10, 1912). There is a marked tendency to seek the cause of chronic iridocyclitis in poisoning from septic teeth or the intestinal canal. These positions are easy to assume, but difficult to prove or disprove. Since both are exceedingly common conditions, why is the consequent iridocyclitis relatively so rare? Doubtless the particular resistance of the individual explains many exceptions. In

recent years the presence of indican in the urine has been taken as proof of the presence of intestinal putrefaction, but the test is only of use when there is a persistently increased reaction. A form of extreme chronic cyclitis is that in which there is keratitis punctata associated with heterochromia and cataract, the affected eye having a lighter colored iris than the normal. Various views are put forward to account for the lesser pigmentation of the diseased eye—either that the pigment is bleached in disease, or that it is a condition original in the patient and indicates either a pure *lusus naturæ* or a congenitally abnormal eye with a weaker resistance to disease. Reviewing these theories Coats' view is that the loss of pigment is the effect of the cyclitis, even though the history might indicate that it was long antecedent to the appearance of the disease. The disease may be so chronic, its onset so insidious, and the first appearance of precipitates require such careful examination to find, that the early discovery of a pale iris is no matter for surprise. Further, that the bleaching is the result of the disease is strongly supported by the fact that similar bleaching is found in interstitial keratitis and chronic glaucoma.

Treatment of iridocyclitis should include the systemic use of remedies directed to the removal of the cause; if syphilis, antiluetic remedies should be vigorously pushed. If of rheumatic or gouty origin, the salicylates (after Gifford's method) should be employed, and the same may be said of the coincidence of Riggs' disease and intestinal toxemias.

Locally, the conduct of the case should be chiefly that of iritis and of cyclitis. (q. v.)

The use of atropine is practically always indicated, both to prevent posterior synechiæ and to put the ciliary muscle and the sphincter pupillæ at rest. In some cases atropin has appeared to increase the inflammatory symptoms. If increased tension should develop it might be necessary to use a miotic: pilocarpin in 0.5 to 2 per cent. solution. Eserin can be used subsequently if necessary. Applications of heat, bathing the eye with hot normal salt solution, and local blood letting, are all of value in relieving the pain, while sweat baths, and the use of Gifford's salicylates, subconjunctival injections, the iodides, etc., must be kept in mind.—(C. P. S.)

See, also, **Cyclitis in general**; as well as **Uveitis**, and p. 3612, Vol. V, of this *Encyclopedia*.

Iridocyclitis, Plastic. See **Iridocyclitis.**

Iridocyclitis, Purulent. See **Iridocyclitis.**

Iridocyclitis, Serofibrinous. Serous cyclitis. See **Iridocyclitis.**

Iridocyclitis, Serous. See **Iridocyclitis.**

Iridocyclitis, Spontaneous chronic. Chronic endogenous iridocyclitis. See **Iridocyclitis.**

Iridocyclitis, Sympathetic. SYMPATHETIC OPHTHALMITIS. See **Sympathetic ophthalmia.**

Iridocyclitis sympathica. Sympathetic iridocyclitis.

Iridocyclitis, Traumatic. See **Iridocyclitis.**

Irido-cyclo-choroiditis. Inflammation of the iris, ciliary body, and choroid, or of the entire uveal tract. See **Uveitis.**

Iridocystectomy. The making of an artificial pupil though an iridocapsular membrane. See page 132, Vol. 1, of this *Encyclopedia.*

Iridodenesis. See **Iridodonesis.**

Iridodesis. (L.) IRIDESIS. An operation for making an artificial pupil for optical purposes only, as in opacity of the cornea or lamellar cataract, the pupil being dislocated toward the periphery of the cornea and iris; devised by Critchett. Also, an operation for lengthening the pupil or changing it into a narrow vertical slit by two small iridectomies at diametrically opposite points on the margin of the cornea, as proposed by Bowman. See **Iridesis.**

Iridodialysis. CORELYSIS. SPHINCTEROLYSIS. Separation of the root of the iris from its attachment to the sclera, either as the result of injury or of operation. See **Injuries of the eye.**

This condition may, however, occur spontaneously. In a case reported by Perlia (*Klin. Monatsbl. f. Augenheilk.*, Dec., 1912) the writer thinks it can only be explained by the complete resorption of a new-growth at this site. He calls attention to Fuchs' explanation of a similar case where the previous existence of a syphilitic nodule was the reason for the apparent spontaneity of the dialysis.

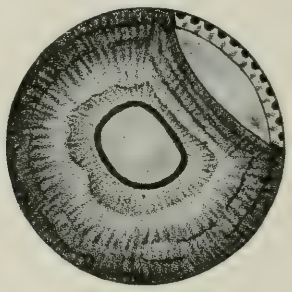
The object of the *operation of iridodialysis* is to open up a peripheral pupil in cases in which but little clear cornea is left. As in such cases the incision for making an iridectomy might cause a part of the clear space to be obliterated by the scar, such an operation may succeed in giving a better result.

The corneal incision is made with a lance-knife in the opaque part thereof, usually near the center. It is best to make it about 2 mm. from the clear part. The iris must not be wounded by the knife. Now a pair of iris forceps or a blunt hook is entered through the corneal incision and pushed forward to the ciliary insertion of the iris. The iris being firmly grasped with the forceps, or engaged with the hook, at its very periphery, is gently pulled away from its ciliary insertion. When this is successfully done the instruments may simply be withdrawn. In other cases it may be possible and advisable to pull the

iris out through the corneal incision and cut it off. This would, of course, mean an iridoëctomy joined to the iridodialysis.

De Wecker, also, recommended cutting at once through the cornea and iris as in iridectomy, and to make with his scissors two divergent incisions in the iris diaphragm to its very periphery. Thus a somewhat quadrangular iris flap is formed which is grasped with forceps and gently torn off from the ciliary insertion.

Jameson (*Archives of Ophthalmology*, July, 1909) publishes notes of four cases of traumatic iridodialysis operated upon with success by a method which does not incarcerate the iris, but brings the torn



Iridodialysis.

margin in contact with a freshened surface, within the anterior chamber.

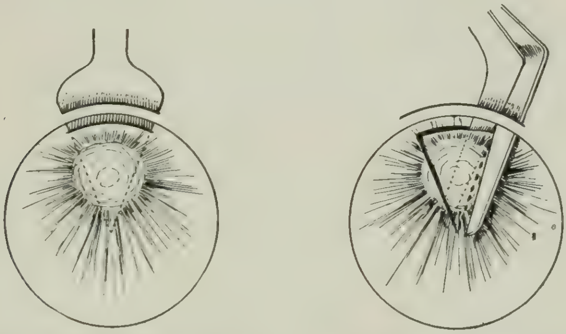
For a description and illustration of this method see **Corelysis,** p. 3323, Vol. V, of this *Encyclopedia*. See, also, **Iridoavulsion**; and **Irideremia.**

Iridodonesis. Tremulousness of the iris, the iris shaking like a thin veil on the slightest movement of the eyeball; due to relaxation of the zonule, dislocation of the lens, fluid vitreous, etc. It is often seen after simple extraction of cataract. It exists in cases where the lens is present, but is shrunken; in certain high degrees of myopia; in some nystagmic eyes; and sometimes follows slight blows upon the eye, causing a rupture of some of the fibres of the zonula so that a communication between the posterior chamber and the vitreous is established. Treatment of this condition is of no avail.

Iridoëctomy. This operation was devised by de Wecker in 1879 for artificial pupil in very thickened capsular membrane, remaining generally after an attempt at cataract extraction. It was made chiefly by the use of his well-known capsule scissors. The method is illustrated by the accompanying figures. As will be observed the pre-

liminary incision was made either with a keratome or by a Graefe knife.

The corneal incision is made as in iridotomy and followed, immediately after the aqueous humor has escaped, by the incision of the iris with the lance-knife. The corneal incision should be about 8 mm. long. Then the pince-ciseaux are introduced at one angle of the iris incision with one blade behind the iris, the other in front of it and push down and towards the center of the diaphragm, as far as



De Wecker's Iridoëctomy with a Lance Knife. (After Valude.)

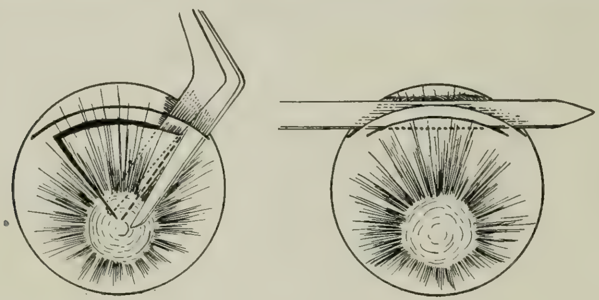
desired, and then the tissues are cut. After this a second incision is made from the other angle of the iris incision. In this manner a V-shaped triangular piece is cut out of the diaphragm which may be drawn out of the eye with the scissors when they are withdrawn, or afterwards with a pair of iris forceps.

In cases in which the iris diaphragm is very thick and unyielding it is better to use a von Graefe knife and make with it a peripheral corneal and iris flap incision. The point of the knife having penetrated into the anterior chamber, it is slightly pulled back to allow the aqueous humor to escape. Then the knife is thrust through the iris diaphragm and carried across to the point of counter-puncture and then the section, which divides iris and cornea at the same time, is finished. It is best, as a rule, to make this corneo-iridic section opposite the original cataract incision. Then the pince-ciseaux are entered in the manner described above and the triangular flap is cut out of the iris diaphragm and removed from the eye.

For certain cases in which the removal of the flap in the manner recommended by de Wecker seems impracticable Abadie (*Ann. d'ocul.*, Vol. 99, 1888) has devised a somewhat different procedure. Two corneal incisions are made at opposite sides of the same corneal diameter, each about 5 mm. in length, with lance-knives. Then the

pince-ciseaux, one blade of which has a sharp point, are entered with this blade through the one corneal section into the iris diaphragm, which is cut by two divergent incisions. Entering a hook or iris forceps through the opposite corneal incision, the iris flap is seized at its apex, drawn out and cut off. (Bourgeois made the two corneal incisions with a von Graefe knife by one thrust.)

Not satisfied with the results of these and similar operations, especially when the iris diaphragm is very tough and offers a great



De Wecker's Iridoëctomy with a von Graefe Knife. (After Valude.)

resistance to knife and scissors, a number of authors have invented instruments with which to punch a piece out of the diaphragm, after an incision into the cornea and iris have been made.

Von Arlt devised and recommended such a punch. Having entered the anterior chamber with it, with closed beak, it is allowed to open far enough to get the iris diaphragm between the two blades. Then when closing the blades with firm pressure a piece of the diaphragm is punched out and withdrawn.

Krueger (*Klin. Monatabl. f. Augenh.*, 1874, p. 429), Howe (*Trans Intern. Med. Cong.*, London, 1888, III, p. 129), and Culbertson (*Am. Jour. of Ophth.*, Vol. I, p. 201) have also devised similar punching instruments.

Iridoëctomy is in most cases a last resort, when conditions are desperate. It is clear, therefore, that not too much must be expected of this operation. It is, perhaps, not astonishing that in such cases hemorrhages are rarely met with, as the blood-vessels have become obliterated, but the manner in which these eyes stand such an operation without any inflammatory reaction is sometimes a surprise.

However, from the very condition in which these eyes are after having passed through severe inflammatory processes, we must not count on restoring a very valuable degree of vision to them, even if the newly made opening in the iris diaphragm remains open, as is usually the case.—(A. A.) See, also, **After-cataract.**

Iridoencleisis. See **Iridencleisis.**
Iridoenkleisis. See **Iridencleisis.**
Iridokeratitis. See **Keratoiritis.**
Iridokinesia. Iridokinesis. The contraction and expansion of the iris.
Iridokinesis. See **Iridokinesia.**
Iridoleptynsis. (Obs.) Atrophy or attenuation of the iris.
Iridology. A proprietary name given to an empirical method of ocular diagnosis. The following quotation from the advertising booklet of the proprietor indicates the character of the system: "The iris of the eye is made up of an immense number of nerve filaments. These filaments receive impressions from every nerve trunk in the body. Every organ and part is represented in the iris in a well defined area. The nerve filaments in these areas portray, by certain signs, changes of color, etc., every passing condition of the corresponding organ or part. Thus we are able to tell the patient, from the eyes alone, his general condition and that of every organ in particular, his inherited or acquired tendencies and the different healing crises through which he will have to pass. Dangerous changes in the lungs, the liver, the spleen, the intestines, etc., are revealed at their very beginning. The patient is warned, and may commence his regeneration at the right time and in the most effective manner. As his cure advances the eye clearly portrays the gradual purification of every part of his system."
Iridolysis. See the major heading, **Corelysis.**
Iridomalacia. (Obsolete.) Softening and degeneration of the iris, an atrophic condition, produced after long-continued inflammation, especially after rheumatic iritis.
Iridomedialysis. See **Iridomesodialysis.**
Iridomelanoma. Iridomelanosis. The deposition of black pigment-masses in the tissue of the iris, either generally throughout the iris, or in circumscribed patches, like nodules or small tumors (which are not malignant).
Iridomelanosis. See *Supra.*
Iridomesodialysis. The loosening of adhesions of the central margin of the iris.
Irido-motor. Subserving motion in the iris.
Iridoncosis. A name formerly proposed by von Ammon for the same morbid state of the iris, as that to which he has since given the name **Iridauxesis,** meaning an (?) abscess of the iris.
Iridoncus. Ireoncion. (Obs.) Tumefaction of the iris.
Iridoodea. (Obs.) An oval conformation of the iris.
Iridoparalysis. Paralysis of the iris.

Iridoparelkysis. Artificial displacement of the pupil by causing a prolapse of the iris.

Iridoparesis. Partial paralysis of the iris.

Iridoperiphacitis. Iridoperiphakitis. An old term that assumes an inflammation of the capsule of the crystalline lens.

Iridoperisphinxis. A series of circular folds in the iris, near the sphincter margin, observed and described by Ammon.

Iridophlebocolops. (Obsolete.) The venous sinus of the iris.

Iridoplania. Hippus. Also, trembling of the iris, or *Iridodonesis*.

Iridoplasma. A term suggested by Gluge to indicate a peculiar degeneration of the eye beginning in the iris.

Iridoplegia. Paralysis of the sphincter of the iris, producing dilatation of the pupil. Immobility of the iris is often seen after severe blows upon the eye (traumatic iridoplegia), rarely after lightning stroke, according to Leber. The pupil is generally moderately dilated, seldom contracted, still less often maximally dilated. In nearly all cases the pupil is irregular—pear-shaped, egg-shaped, transversely oval, or locally dilated in one part. Atropin acts very slowly, and causes only incomplete dilatation, perhaps due to absence of effective stimulation of the dilator through the sympathetic fibres. In some cases Schmidt-Rimpler has shown that the least dilated part before the use of atropin corresponds with the site of injury to the sclerocornea. The pupil may be quite immobile or may react sluggishly to light. The mydriasis may pass off, usually very gradually, in the course of weeks or months, or may be permanent. Hirschberg reported a case in which the mydriasis disappeared completely in two days. Hyphema and ruptures of the sphincter are very common accompaniments. Vision is usually much depressed, with photophobia; these symptoms generally pass off quickly and completely. There is often paresis or paralysis of accommodation, and the intra-ocular tension may be lowered. Rarely, there is myopia, due to spasm of accommodation, or myopic astigmatism may be due to injury of the lens. Opacity of the cornea and aqueous, vitreous hemorrhage, subluxation of the lens, cataract, etc., may occur; more rarely retinal and choroidal hemorrhages or rupture, detachment of the retina, macular changes, optic atrophy, etc. (Parsons). In certain cases of partial iridoplegia observed by Markus (*Trans. Ophth. Soc. of the United Kingdom*, 1906, p. 50), the pathological significance of the pupil changes he believes to be still an open question. The association of the pupil anomaly with absence of knee-jerk, might be considered sufficient evidence of congenital syphilis, but Marcus questions whether

the condition might not be regarded as an instance of abiotrophy in the sense of Sir William Gowers.

Unilateral reflex iridoplegia is a condition in which one pupil does not respond to the stimulus of light, either directly or consensually, but does correspond to efforts of convergence. It may be associated with paralysis of accommodation. The affected eye almost always presents a pupil larger than its fellow and pronounced mydriasis is the condition in a large number of cases. Vision is not impaired. The lesion is probably at or near the sphincter nucleus. Syphilis, either inherited or acquired, is the cause in almost all cases. The prognosis is fairly favorable if vigorous anti-syphilitic treatment is instituted early in the course of the affection. If some months or years have elapsed very little can be expected from treatment.—(C. P. S.)

Iridoplegia, Reflex. See **Argyll Robertson pupil.**

Iridoplegia traumatica. See **Injuries of the eye.**

Iridoptosis. An old term for prolapse of the iris through a perforating wound or ulcer of the cornea.

Iridopupillaire. (F.) Pertaining to or connected with the pupillary border of the iris.

Iridorhexis. IRIDORRHEXIS. Laceration of or tears involving the whole iris. See **Injuries of the eye.**

The term is also applied to an operation introduced by Desmarres as a procedure of value where part of the posterior surface of the iris is firmly glued to the lens, and the execution of an iridectomy is thereby impeded. In reality this operation does not differ from an ordinary iridectomy, except that the iris is with force torn loose from its adhesion to the lens. In order to do this with better success Desmarres' recommendation was to enter the closed iris forceps with the concavity forwards, through a rather large corneal section, and to shove it towards the adhesion, so that the end of the forceps lies just over it. As large a piece of iris as possible is then seized, not with the biting end, but between the branches of the forceps. This must include any subjacent exudative masses. With a rapid pull the iris is torn off from its adhesion, the forceps remaining within the anterior chamber. If the iris has come away from the lens it may then be pulled out of the eye and be cut off.

Iridorrhagas. An old term for coloboma iridis.

Iridorrhytidoma. IRIDORRHYTIDOSIS. (Obs.) Corrugation of the iris.

Iridoschisis. (Obs.) The formation of an iridoschisma.

Iridoschisma. A name proposed by Gescheidt for coloboma of the iris. The term never came into very general use. "Coloboma iridis"

was invented by von Walther, who was also the first to attribute the deformity in question to an arrest of development instead of to a lesion received *in utero.*—(T. H. S.) See **Coloboma, Iris.**

Iridosclerectomy. Lagrange's operation. An operation devised by Lagrange for the purpose of forming a filtration cicatrix, in the treatment of glaucoma. See **Glaucoma.**

Iridoscope. An instrument for viewing the interior of the eye.

Iridosis. The operation of forming a new pupil or changing the position of the old by tying a slip or slips of it in an opening made in the cornea.

Iridosteresis. Irideremia. Absence or loss of the iris.

Iridotasis. Iridenkleisis. Borthen's operation. Stretching the iris. The steps of this operation for glaucoma are as follows: The conjunctiva is grasped with fine straight forceps about 10 mm. back of the upper limbus and a cut 2 to 3 mm. long made in the raised conjunctival fold with ordinary iris-scissors. The scissors are then carried toward the limbus, dissecting a conjunctival flap and keeping as near to the scleral surface as possible in order to include a large amount of subconjunctival tissue in the flap. Care must be taken to avoid fenestrating the conjunctiva near the limbus, as this would not only expose the incarcerated iris to infection, but interfere with filtration as well. The globe is now held with fixation forceps, and the lance knife, with a stop, introduced about 1 mm. back from the sclero-corneal margin, and carried down through the anterior chamber until the section is 4 to 5 mm. long. Dissection of the conjunctival flap with scissors insures the inclusion of subconjunctival tissue in the flap, a matter of importance for filtration and the formation of a subconjunctival bleb. The iris is now grasped at the sphincter with the iris forceps, taking up a fold 1 to 2 mm. wide, drawn out through the section and left there. Borthen, up to 1913, had reported a total of 97 cases, all of which had been successful with the exception of a few cases of hemorrhagic glaucoma. Harrower (*Trans. Am. Ophth. Soc.*, 1913) reported two cases, both of which were successful. Dunbar Roy (*Trans. Chicago Ophthalmological Society*, Nov. 15, 1915) reported nine successful cases, and strongly recommended this operation, where no contraindications exist, for both the acute and chronic forms of the disease. See p. 5525, Vol. VII, of this *Encyclopedia.*

Iridotencleisis. See **Iridencleisis.**

Iridotome. A cutting instrument for use in iridotomy.

Iridotomedialysis. Iridomesodialysis. The loosening of adhesions of the central margin of the iris.

Iridotomencleisis. See **Iridencleisis.**

Iridotomy. Iritomy. Improperly, Irotomy. In this operation the iris is incised, as a rule, within the eye in order to produce a pupil. This is principally done in eyes in which a previous iritis or iridocyclitis has resulted in the closure of the pupil. It is rarely performed, and then only for very special reasons, in eyes with a normal pupil.

Iridotomy was first performed by Cheselden (*Philosoph. Transactions*, London, 1728, Vol. XXXV, p. 457). Yet, Woolhouse in 1711 had conceived the idea of reëstablishing a closed pupil, without, however, injuring the iris tissue. Cheselden used a sickle-shaped needle, which he entered through the sclerotic on the temporal side and then cut through the iris from behind. In 1756 G. Heuermann (*Abhandlung*, Copenhagen and Leipzig, 1756) used a double-edged, lance-shaped knife for making an iridotomy. He entered it through the cornea and then incised the iris. Janin (*Mémoirs*, Lyon, 1772) replaced the knife by scissors. These were entered through the corneal incision in order to cut the iris.

Beer (*Lehr. d. Augenheilk*, Wien, 1792) published his method, which he offered as an improvement on Cheselden's. He went, with a lance-knife, through the cornea and then through the central part of the iris, or near it, at right angles to the traction of the scar. Thus his method was very similar to that of Heuermann. Maunoir improved on Janin's method by using scissors with a sharp point on one and a blunt point on the other blade. With these he entered through the corneal incision and incised the iris twice, the cuts forming a V with the point near the centre. Thus a triangular iris flap was formed which was either permitted to shrink or was excised. Mackenzie (*Diseases of the Eye*, 3rd Edition, London, 1840) made the V-shaped iris incision across the stretched fibres and with the apex near the corneal incision. Von Graefe, in 1869, urgently recommended us to make the iridotomy with a sickle-shaped knife-needle, or with a small myrtle-leaf-shaped, two-edged knife.

Bowman (*Trans. Fourth International Congress*, London, 1872) made two corneal incisions on opposite sides of the cornea, followed by a V-shaped iris incision through each one, so that the bases of these triangles joined each other. Thus a rhomboid mass of tissue was freed, which could be withdrawn with iris forceps.

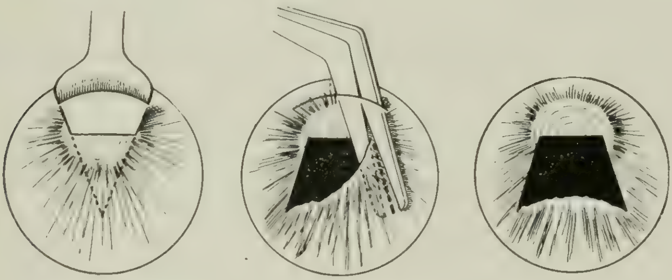
In spite of the undoubted success from iridotomy in the hands of these operators the procedure was not generally adopted until de Wecker (*Annales d'Oculistique*, 1873) introduced a new instrument, his *pince-ciseaux*, or forceps-scissors. The small, cutting blades of these scissors are set almost at right angles to the handle and are closed by pressure on the latter.

De Wecker recommended both a single and a double iridotomy. The former was intended for eyes with an intact lens and a free pupillary edge. He made the corneal incision with a stop-lance knife, to insure an opening of 4 mm. and no more. The middle of this incision lay on the meridian in which he desired to make the iridotomy, but at right angles to it. When this incision was made he withdrew the knife slowly and with care.

The pince-ciseaux he used in simple iridotomy had two blunt points and were very smoothly finished. These he introduced into the anterior chamber with the blades closed and pushed them forward to the opposite pupillary edge of the iris where he desired to make the iridotomy. The blades being now opened no farther than necessary for the object in view, one of them was slipped in between iris and lens as far as desired and by a quick closure the sphincter edge of the iris and as much of the iris tissue as necessary were cut in the line of a radius. Then the scissors were withdrawn. Such a simple iridotomy has, of course, a very limited field of usefulness and its application is to lamellar cataract, central opacity of the cornea and to some cases of dislocation of the lens. Von Hasner (*Zeitschr. f. Heilk.,* 1881) made a simple iridotomy instead of an iridectomy in his cataract extractions. While in its proper place a useful operation, simple iridotomy is rarely used on account of the danger of wounding the lens. Schoeler (*Berlin, Klin. Wochenschr.,* 1886) tried to obviate this defect by causing the iris to prolapse through the corneal incision and cutting the sphincter edge outside of the eye with small scissors. After this he replaced the iris by means of a spatula. In this operation, contrary to de Wecker's, the iridotomy lies on the same side of the iris as the corneal incision. The operation of Schoeler offers a greater chance for infection, since the iris is drawn out and cut outside of the eye.

In closure of the pupil, especially after the operative removal or loss of the lens by an injury, de Wecker recommended his double iridotomy, which he performed in the following manner: The point of a lance-knife is entered at the corneal periphery at the place towards which the iris is pulled by the contracting scar. Since the incision for the extraction of cataract is usually made upwards, the new incision, usually, also, lies upwards. The knife, having entered the anterior chamber, is pushed through the iris and whatever capsular or cyclitic tissue is adherent to its posterior surface. Then the knife is withdrawn and the pince-ciseaux are entered, with one blade behind and the other in front of the iris, at one angle of the corneal incision, and the interposed tissue is cut. The scissors are then moved to the

other angle of the corneal incision and another cut through iris and adherent tissue is made, converging toward the first or diverging from it. The three iris incisions, one by the lance-knife and the two by the scissors, include a flap which by its shrinkage will establish a pupillary opening. Green (*Trans. Am. Ophth. Soc.*, Vol. II, 1876) pointed out that it is best to place the incision so as to divide at right angles such fibres of the iris as are seen to be in a state of abnormal tension. He made only one incision into the iris, placed as near the centre of the diaphragm as possible, by which an oval horizontal pupil was obtained.



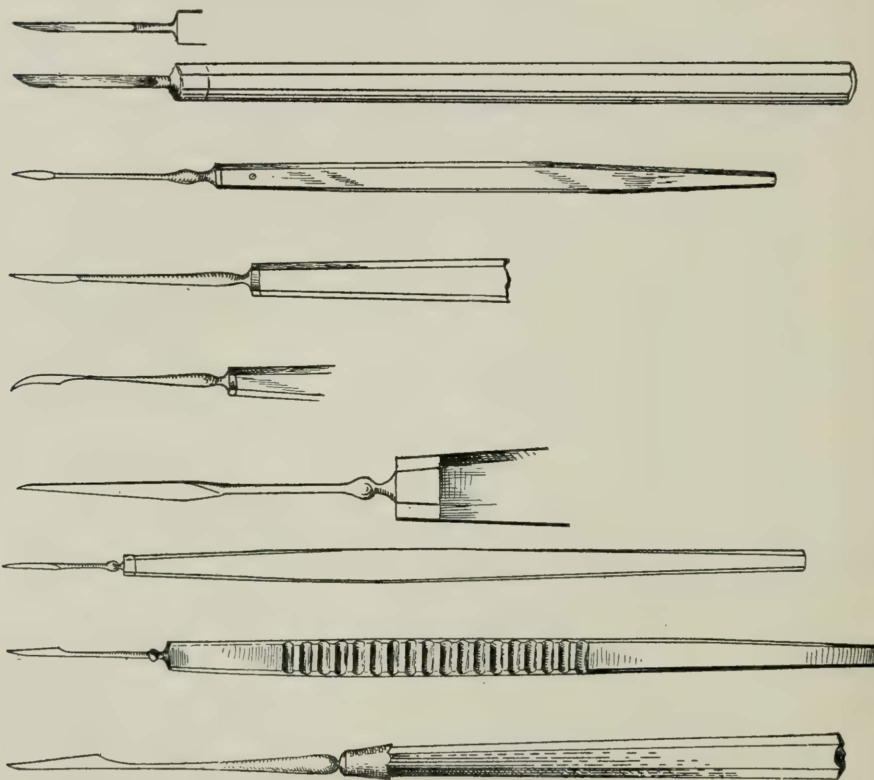
Double Iridotomy, de Wecker's Method. (After Valude.)

Under favorable circumstances such iridotomies may establish a permanent pupillary opening. However, not infrequently, when the insidious inflammatory process is not cut short by the iridotomy the artificial pupil is in part or altogether closed again. This seems to be more apt to occur when a hemorrhage into the opening and the anterior chamber has followed the operation. This accident may call for one or several repetitions of the iridotomy until a permanent opening results. A second attempt should, however, be delayed until the eye has been free from all irritation for some time.

The use of scissors, even the pince-ciseaux, for making an iridotomy was, by many operators, objected to on account of the necessity of a separate corneal incision. These surgeons preferred a small knife or knife-needle. The incision of the iris with the lance-knife being often followed by a severe hemorrhage, the field of operation is quickly obstructed and the introduction of the scissors made almost, if not altogether, impossible. Sometimes vitreous will be lost, especially if it is abnormally fluid; in that case the eye may become so soft that the operation can be completed only with great difficulty, and the future of such an eye offers little hope of permanent success. By the use of a knife or a knife-needle most of such accidents may be avoided

and a hemorrhage, while it may occur, will not come on before the knife has done its work.

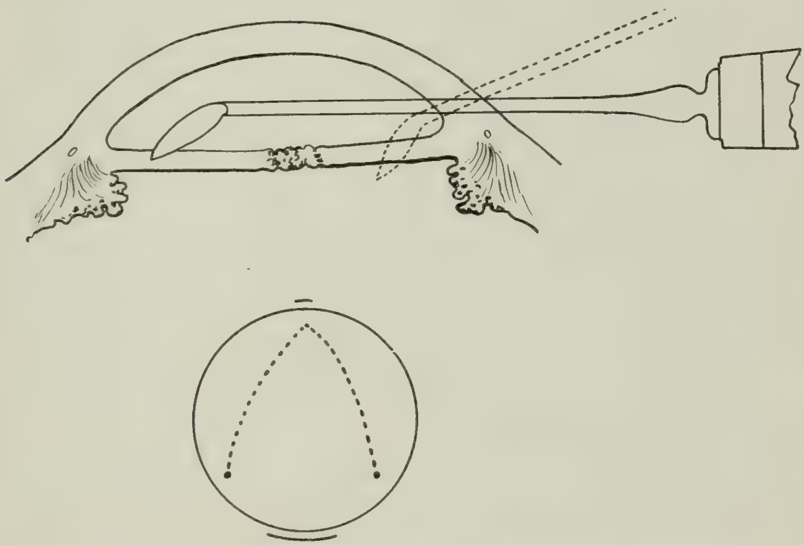
The knife-needle which Hays (*Am. Jour. of Med. Sciences,* July, 1885) recommended was nearly a reproduction of Cheselden's, only of much smaller size, and it became very popular in the United States. While von Graefe again recommended a knife-needle or a sickle-shaped



The Various Knife-needles and Iris Knives Recommended for Iridotomy. (After Ziegler.)

knife, Gayet (*Progrés médical,* No. 35, 1880) used a von Graefe knife in making an iridotomy. He went through the cornea and iris vertically to the iris surface, then changed the direction of the knife so as to go behind the iris with the point, and pushing it forward the desired distance came out through the iris again. He then finished the incision in the iris between these two points when withdrawing the knife (with a sawing motion) and without enlarging the corneal incision. Scherk (*Klin. Mtsbl. f. Augenhlk.,* Vol. XXI, p. 315, 1883)

thought it paradoxical to relax (by means of a corneal incision) a tense membrane which it is desired to cut through. This and the general objections to using scissors in performing an iridotomy prompted him to employ a small knife similar to a discission needle, with which he cut through the iris with a sawing motion and little or no loss of aqueous humor. Sichel (*Klin. Mtsbl. f. Augenhlk.*, Vol. XV, p. 273, 1877) had previously recommended a similar procedure with a knife of his own devising. Knapp's knife-needle, which was originally used by him for capsulotomy, is also useful and often used in making an iridotomy.



Jobson's Iridotome and Iridotomy.

Ziegler (*Trans. Section of Ophth. A. M. A.*, 1908) published his method of making a V-shaped iridotomy and introduced a new knife devised by him for this operation. He says: "The character of the incision in the iris membrane is of vital importance. It should be a double incision. Our advice is to employ a V-shaped one which is undoubtedly the only one that will cut through all the iridic fibres in such a way as to give us the greatest retraction of the membrane. Absolutely no pressure should be made in cutting with the knife-needle." See p. 132, Vol. I of this *Encyclopedia.*

In the same year, 1908, a new method of iridotomy and a new knife for making it were proposed by Jobson (*Ophth. Record*, Sept., 1908). Jobson's knife is similar to a cystotome with a large blade set at

"a carefully calculated angle." He says: "This knife makes its own incision in the globe and cuts with a minimum amount of dragging." The incisions he makes in the iris diaphragm with this knife are almost the same as Ziegler's.

The history of iridotomy shows that it was begun with a knife and is today again, as a rule, performed with a knife even in spite of de Wecker's very useful scissors. The variations in the shape of the knife have been many. The writer now prefers Ziegler's to all others. The victory of the knife shows that in most cases, and in the hands of the majority of operators, it was found to be the superior instrument. It is true that there are some cases in which the tissue mass to be cut in order to make a pupil consists of iris, lens capsule, lens remnants (oftentimes containing lime deposits and cyclitic membrane) and is too tough for a knife-needle to pierce. In such a case the scissors, and, above all, de Wecker's pince-ciseaux are still in place.—(A. A.)

Frank Brawley (*Ophthalmic Record*) has invented an ingenious knife-needle for the same purpose. It has an effective waved edge, like a "bread" knife, for incising the iris and other tissues. See, also, **After-cataract**; **Cataract, Secondary**; as well as **Knife-needle.**

Iridotromos. Iridotromus. Obsolete synonyms of *iridodonesis* or trembling of the iris.

Iridovalosis. A synonym of *iridoodea.*

Irien. (F.) Iridian; iridal.

Iriodesis. See **Iridodesis.**

Iriododilator. Dilator of the pupil.

Iris. This important ocular membrane is a circular, colored curtain, suspended in front of the crystalline lens and pierced by an opening called the *pupil.* Structurally, the iris is a spongy, elastic, connective-tissue membrane, made up principally of vessels, nerves, and unstriped muscle, bound together by a very loose cellular stroma. This consists of a small amount of fine fibrous tissue, with branching spindle- and star-shaped cells, with long interlocking processes; most of them contain brown pigment granules, varying in amount according to the color of the iris, and absent in albinos. The vessels run radially, with the exception of the circulus arteriosus iridis minor, which is situated a short distance from the pupillary edge. The major arterial circle lies in the ciliary body, at the root of the iris. The posterior part of the stroma near the pupillary edge is occupied by a ring of unstriped muscle, the *sphincter iridis.* This is inserted by oblique off-shoots into the posterior wall, so that the posterior pigment layer is often seen to be drawn into a fold. The anterior surface is irregular, and is covered by endothelium, continuous with that of ligamentum pec-

tinatum. There are breaks in the continuity of the endothelium, leading down into irregular spaces or *crypts* in the stroma, which thus communicates directly with the anterior chamber. The posterior surface of the iris is covered by a double layer of *retinal epithelium* (*pars retinalis iridis, pars iridica retinæ*). This is deeply pigmented, except in albinos. The pigment granules are dark-brown, mostly round, but some are rod-shaped, like the retinal pigment in lower animals. *The coloration of the iris* depends not so much upon the actual color of the pigment as upon the arrangement of the pigmentation.

The iris is attached at its periphery to the ciliary body. It separates the anterior from the posterior chamber, and regulates, by means of the expansion and contraction of the pupil, the amount of light admitted to the eye. When fully contracted, the pupillary margin of the iris lies on the anterior surface of the lens, but when the pupil is dilated it floats free in the aqueous humor. Contraction of the pupil is effected by the *sphincter pupillæ.* In miosis the pupillary zone of the iris is stretched and increased, the crypts are pulled out into radial slits, and the furrows are flattened out. The retinal layer is pulled farther forwards, so that there is a physiological ectropion of the pigment layer. The iris is thinned, the section of the sphincter is elongated and brought parallel to the pigment layer, its pupillary third being slightly bowed forwards. The retinal epithelium is flattened.

Hirschberg (*Centralbl. f. pkt. Augenheilk.*, August, 1912) observed in the right eye of a woman, aged 73, a circumscribed thickening of the sphincter iridis at the lower temporal eighth of the pupillary margin. This prominence showed *vermiform contractions* in its longitudinal axis and towards the pupil, while the remaining portion contracted in the usual way towards the center of the pupil. It looked as if a worm by alternating contraction and relaxation of its longitudinal muscles was creeping around the pupil. The thickening also remained in artificial mydriasis. It seemed to the author to be a congenital, circumscribed hyperplasia of the sphincter.

Sattler also reports that, from a wider search with Zeiss' corneal microscope, he has observed eleven cases of such vermicular or peristaltic contraction of the sphincter of the pupil. The patients varied from 11 to 45 years of age, and suffered from various general diseases. But such contractions were generally observable only in sluggish or immobile pupils. The contraction ceased after instillations of atropin or pilocarpin, but were not influenced by cocain. Erlenmeyer (*Berl. Kl. Woch.*, 49, p. 539) reports the case of a woman of 42 who had

attacks at times of what he calls "wandering pupil." During about twenty seconds the pupil spread and twisted, becoming oval and then stretching out long, with the longest axis slanting or transverse. He compares the movements to those of the ameba and explains them as a hysteric clonic spasm of the iris.

Münch (*Klin. Monats. f. Augenh.*, Apr., 1912, also June, 1912) points out that the sphincter pupillæ consists of from seventy to eighty more or less independent though intimately connected physiologic segments, each of which is supplied by a nerve twig. When the pupil is moderately dilated, under weak light and adapted retina, its movements are decidedly peristaltic in character, the contraction being only apparently uniform. Although the view of Münch has not been universally accepted, it appears to have the support of many acknowledged authorities, and Münch says he still adheres to the belief in the muscular nature of the iris stroma cells, in which transverse striation, fibrillary striation, splitting of the cells into fibril bundles, and typical muscular nerve endings, have been demonstrated. He points to the state of the pupil after death, miosis setting in after the cessation of rigor mortis, in support of his own view.

Dilation of the pupil is due (1) to paralysis of the *sphincter pupillæ,* (2) contraction of the muscular coat of the iridic arteries, and of (3) unstriped muscular fibres that radiate from the margin of the pupil to the ciliary body. The last two sets of fibres are controlled by the sympathetic, while the sphincter of the pupil is supplied by the third nerve.

In mydriasis the pupillary zone is narrowed and folded in, so that it forms a cup: the pigmented border becomes thin and may disappear. The ciliary zone is narrowed and thrown into concentric folds, the summits of which approach nearer to the back of the cornea, and may nearly touch it.

The pupil is closed, until the seventh month of fetal life, by a thin, semi-transparent membrane, which occasionally persists, in part or whole, after birth, under the name *persistent pupillary membrane.* See **Congenital anomalies.**

With the ciliary body and choroid, whose structure it closely resembles, the iris forms the *uveal tract* for providing nourishment to the interior of the eye-ball.

The arteries of the iris are branches from the long and anterior ciliary and the vessels of the ciliary processes. The two long ciliary arteries pierce the sclera on each side of the optic nerve, pass forward between the sclera and choroid, and divide into branches forming a vascular ring, *large arterial circle,* around the periphery of the iris.

From this circle small branches pass to the ciliary muscle, while others run toward the pupil, around which they form the *small arterial circle.* The five or six anterior ciliary arteries arise from the muscular and lacrimal branches of the ophthalmic artery and pierce the sclera just behind the cornea. They supply the ciliary processes and join the great arterial circle. In addition to these, other small arteries pass from the ciliary processes to the iris. The anterior conjunctival arteries are small vessels which become prominent in inflammatory conditions of the conjunctiva.

The veins of the iris follow the course of the arteries and end in the venæ vorticosæ. See p. 408, plate *f,* Vol. I of this *Encyclopedia.*

The nerves of the iris are numerous. They come from the ciliary branches of the lenticular ganglion and the long ciliary. There are about fifteen of the former. They pierce the sclera around the optic nerve, pass forward imbedded in grooves on the inner side of the sclera, and communicate before distribution. They supply the cornea, ciliary muscle, and iris. In the iris they follow the course of the vessels and form a plexus of non-medullated fibres. Fibres from the motor-oculi supply the sphincter pupillæ. The nerve supply of the dilator fibres is in dispute. Many authors state that the dilator is supplied by the sympathetic, but late researches show that the dilator fibres do not have their course exclusively through the cervical sympathetic. After excision of the superior cervical ganglion and an inch of the sympathetic nerve below it, the pupil reflex has been found to be present (Ball). This observation seems to confirm the view of those physiologists who hold that dilating fibres pass out directly from the brain along the fifth nerve.

Juselius (*Klin. Monatsb. f. Augenh.*, July, 1908) finds that the *development of the sphincter iridis,* from the anterior ectodermal layer of the secondary optic vesicle, commences at a period when the embryo is about 8 to 9 cm. in length. Wolfrum has found anomalies in the closure of the secondary optic vesicle—incarcerations of the margins—which he believes may play an important rôle in the production of colobomata.

Vollaro's researches (*Zeitschr. f. Augenh.*, Jan., 1908) show that the posterior limiting membrane of the iris, or Bruch-Henle's membrane, consists of a continuous myoidal structure forming a true dilator. The same observer has shown that the human iris possesses a system of radial elastic fibers in the posterior layers of its stroma. A few isolated elastic fibers are also found in the sphincter zone. The iris of domestic mammals possesses, besides a system of radiating fibers in its posterior layers, numerous elastic fibers in the interstices

of the stroma. The irides of both birds and fishes are extremely rich in elastic tissue.

Münch (*Klin. Monats. f. Augenh.,* Jan., 1908) claims, as against the objections of Wolfrum, that his preparations demonstrate the fibrillary nature of the iris stroma cells. Lauber confirms this observation in his contributions to the embryology and anatomy of the iris. Wolfflin describes small white nodules situated close to the ciliary border of the iris. They are more common in blue than brown irides, and are possibly the remains of the pupillary membrane. Numerous sections by Henderson show that Schlemm's canal is nothing other than a prolongation of the veins of the iris; the so-called circulus arteriosus iridis major is in reality a sinus venosus iridis.—(C. P. S.)

See, also, **Anatomy of the eye**; as well as **Histology of the eye**; **Comparative ophthalmology**; and **Development of the eye.**

Iris, Absence of the. See **Aniridia.**

Iris, Anomalies of the. The iris is subject to various congenital anomalies. They are chiefly coloboma, persistent pupillary membrane, corectopia, polycoria, aniridia, ectropion of the uvea, heterochromia, albinism, tumor, atrophy, and adhesion to the cornea. Each of these anomalies is discussed under its appropriate heading. See **Congenital anomalies of the eye.**

Iris, Anteversion of the. This may follow iridodialysis, the iris being twisted upon itself so that the pigment layer shows in front. The treatment is rest and atropin. See **Injuries of the eye.**

Iris, Aplasia of the. See **Iris, Atrophy of the.**

Irisated. Irised. (Obs.) Iridescent.

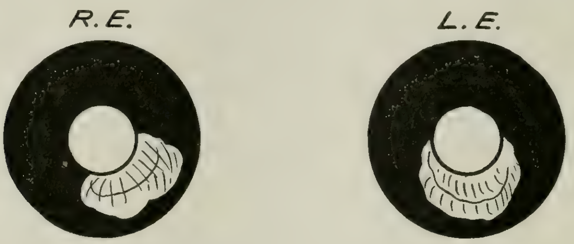
Iris, Atrophy of the. This condition results from repeated attacks of acute or sub-acute iritis, of chronic iritis, glaucoma, and other diseases that lead to degenerative changes in the eye. The formation of new fibrous tissue upon the surface of the iris, as a result of the organization of exudates in plastic iritis, by its contraction leads to pressure and tension in the neighboring stroma, the cells of which degenerate, first losing their long ramifying processes, and finally atrophying in large numbers entirely. The contraction of a superficial lamina of fibrous tissue also leads to deformation of the iris. The pupillary border of the iris is pulled outwards, so that the iris becomes bent upon itself. In this manner the retinal pigment layer is dragged for a variable distance over the anterior surface, and the condition known as *ectropion of the pigment layer* is produced. This is particularly common in glaucomatous eyes. When the distortion is more pronounced, the sphincter takes part in the process, so that it appears hook- or horseshoe-shaped in radial section.

In the majority of cases which are examined microscopically the iris is uniformly degenerated and thinned, and this is most obvious at the root, where the iris is normally thinnest. All parts of the structure participate in the process. The normal, loosely-constructed stroma may retain its spongy nature, though it is obvious that much of the tissue has disappeared. More commonly the loose stroma is replaced by denser fibrous tissue containing flattened cells with stunted processes, and often clumps of pigment. Most of the chromatophores have been replaced by these non-pigmented cells. The muscle fibres persist longer, so the sphincter is generally easily recognized, though also degenerated, and more or less replaced by hyaline connective tissue. The blood-vessels often show a high degree of peri- and end-arteritis, sections showing the usual picture of thick, hyaline rings enclosing a minute lumen, which may contain pigment. In other cases scarcely any vessels are to be seen, and sometimes the largest of these are obviously vessels of inflammatory new-formation. In many cases spherical hyaline globules, staining deeply with eosin, are seen in the intercellular spaces. They often occur in the iris in anterior staphyloma in conjunction with hyaline changes in the cornea. The globules, which vary in size and sometimes form considerable concretions which may later calcify, are scattered throughout the stroma, and even in the endothelium and pigment epithelium.

Parsons especially points out that while the pigment epithelium is very resistant, it also shows degenerative changes. It may be uniformly thinned, but more often is irregular—thin or absent in places, while aggregated in clumps elsewhere. In high degrees of atrophy it has almost entirely disappeared; it is in such cases that a red reflex is obtained through the iris with the ophthalmoscope. The endothelium may be unaltered, but is often very much thickened. Warty outgrowths may be formed like those upon Descemet's membrane. The cells may be well formed, with well-stained nuclei; but more frequently they are degenerated, possessing few or no nuclei; being transformed into hyaline masses. A common phenomenon, first described by Wagenmann, is the formation of a hyaline membrane upon the surface of the iris. It occurs generally in glaucomatous eyes, in which there is a peripheral anterior synechia. At the false angle Descemet's membrane is continued over the iris, or appears to split; the endothelium is similarly continued from the back of the cornea on to the new hyaline membrane, and may even pass over the pupillary border on to the pigment epithelium at the back of the iris. The hyaline membrane is usually thin (5-6 μ), but may have warty excrescences; it is doubtless a secretion product of the endothelium cells.

Calcareous deposits sometimes occur in the atrophic iris. Rarely bone lamellæ are found, but almost invariably they are formed by extension from bony deposits in the choroid.

Mayou (*Ophth. Review,* June, 1909) explains that disappearance of the whole or parts of the iris as a result of injury had been frequently noticed, and was due to many causes, but the one he specially wished to refer to was the retraction of the iris into the angle of the anterior chamber owing to organization of fibrous tissue, giving rise to an apparent aniridia. The best known causes of disappearance of the iris are: (1) Incarceration in a scleral wound; (2) avulsion of the iris in the rupture of the globe, caused by forcible expulsion of the aqueous; (3) retroflexion of the iris, and (4) rupture of the ligamentum pectinatum, cases of which have been described by Treacher Collins in 1892, and by Buchanan and Müller.



Binocular Localized Atrophy of the Iris. (Coover.)

Coover reports a case of a man with atrophy of each iris. The altered area occupied a space concentric with the lower margin of each pupil, extending back about 2½ mm. from the pupil and 6 to 8 mm. laterally. The iris vessels, stroma, pigment cells and most of the sphincter were gone. The radiating, but few of the circular, fibers showed. The iris reacted to light elsewhere, but not in the atrophic part. A hypermature cataract showed through the atrophic iris in one eye. There was no history of injury or inflammation in either eye.

Coover later removed the cataract, making the incision above and doing a small iridectomy. Through the atrophied segment of iris below, and the operative coloboma above, the usual black appearance of the fundus showed to the unaided eye. Most of the cortex was liquid and the nucleus firm, the cataract being of the congenital type.

Reitsch (*Klin. Monatsbl. f. Augenh.*, V. 53, p. 545, 1913) found in both eyes of a man, aged 54, who for years had been suffering from chronic uveitis, atrophy of the ciliary zone and total atrophy of the pupillary zone of the iris. The dark pigment epithelium showed

through. The slight gray tissue ring, connecting the iris and anterior capsule, suggested a former pupillary exudate, partly absorbed. From this ring very fine, almost rectilinear threads of stroma coursed to the ruffle of the iris, and a few radial blood vessels were noticeable. The synechial ring was almost covered by contraction of the sphincter, which was limited by atrophy of the sphincter (visible on transillumination), and immobility of the remaining tissues of the iris.—(C. P. S.) See, also, **Iris, Essential atrophy of the.**

Iris-Bildungsfehler. (G.) Malformation of the iris.

Iris bombans. Iris bombé.

Iris bombé. When the whole circle of the pupil becomes adherent to the lens a *ring synechia* is produced and the anterior chamber is shut off from the posterior chamber, thus constituting a *seclusio pupillæ.* When this happens it often leads, later, to a bulging forward of the iris in consequence of the aqueous humor accumulating behind it. This may, in turn result in an adherence of the balooning iris to the posterior wall of the cornea and a secondary glaucoma. Finally, exudates may organize in the pupillary area (*occlusio pupillæ*) and a total posterior synechia forms.

The *treatment* of iris bombé consists in transfixing the iris. A very narrow von Graefe cataract-knife is passed through the cornea and bulging iris, and withdrawn. The cut establishes a communication between the anterior and posterior chambers. At the same time retraction of the distended membrane practically forms a new pupil. See, also, **Annular synechia.**

Iris, Bridge coloboma of the. In that form of coloboma of the iris where the cleft is spanned by a membrane, the condition is known as a "bridge-coloboma." See **Congenital anomalies of the eye.**

Iris, Cholesteatoma of the. Implantation cysts may follow a cataract extraction, or any corneal wound which drags epithelium or hairs into the anterior chamber. These tumors present a mother-of-pearl appearance due to cholesterin crystals. They are called pearl-cysts, or cholesteatomata. They contain a lining of laminated epithelium and semi-solid contents, consisting of degenerated epithelial cells and fat-globules. See **Cysts of the iris**; and the illustration of **Iris, Cyst of the.**

Iris, Chromatic asymmetry of the. See **Iris, Heterochromia of the.**

Irisch-römisches Bad. (G.) Turkish bath.

Iris coloboma. A fissure in the iris, of varying size and shape, due to arrest of development. It may affect one or both eyes and is usually accompanied by a coloboma of the ciliary body and choroid. The fissure is triangular or pyriform in shape, with the base toward the

pupil and the apex toward the periphery, though it may not extend quite to the periphery. See **Congenital anomalies**; and **Coloboma, Iris.**

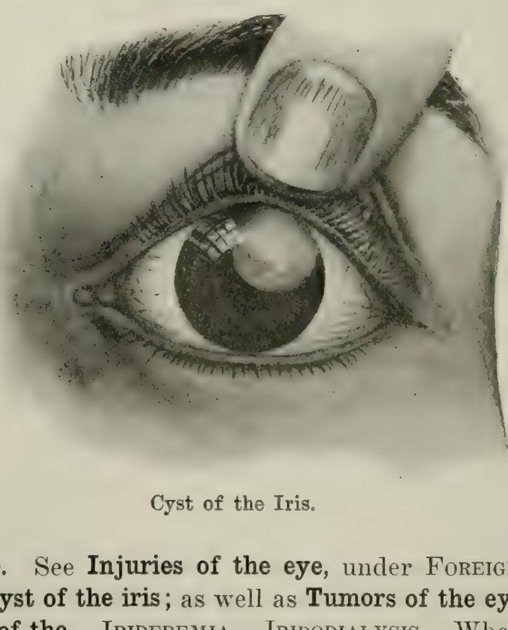
Iris, Condyloma of the. See **Iritis**; also **Iris, Tumors of the.**

Iris, Congenital anomalies of the. See **Iris, Anomalies of the.**

Iris, Congenital tumors of the. The number of congenital tumors of the iris on record is small. Endothelial cysts, when congenital, must be accounted for by assuming that a crypt of the iris becomes closed, and fluid collects in it. A few cases of congenital dermoid cyst have been reported. See **Congenital anomalies of the eye.**

Iriscope. An instrument for the exhibition of interference colors.

Iris, Cysticercus of the. The parasite appears in the anterior chamber as a round, whitish, grayish, or yellowish mass, about 1 mm. in diameter. At one particular part of the cyst a whitish projection is noticed which changes its shape from time to time. The mass may be found in the bottom of the anterior chamber or it may float free in the aqueous. At the time it breaks forth from an iris vessel there is great pain. The parasite should be removed through an incision made in the cornea. See, also, **Iris, Tumors of the**; and p. 3668, Vol. V, of this *Encyclopedia;* also, **Parasites of the eye.**



Cyst of the Iris.

Iris, Cysts of the. See **Injuries of the eye,** under FOREIGN BODIES IN THE IRIS; also **Cyst of the iris**; as well as **Tumors of the eye.**

Iris, Detachment of the. IRIDEREMIA. IRIDODIALYSIS. When complete, this is an extremely rare condition. Two cases were recorded by

de Beck, both of which sustained blows producing rupture of the cornea and extrusion of the iris without injury to the lens. See **Injuries of the eye**; and **Iridodialysis.**

Iris, Development of the. Soon after the separation of the lenticular sac from the ectoderm, a thin layer of mesenchyma is found between them, which by migratory cells greatly increases in thickness. The inner layer, adjoining the capsule of the lens, represents the pupillary membrane (membrana vasculosa); the external one forms the cornea. These two layers become well defined only when, by a cleft between them, the anterior chamber begins to form. At the same time the external and internal layers of the eye-cup assume different properties. The external remains thin and is converted into a pigmented lamella by the deposition due to an active proliferation of its cells. A differentiation also is seen between the base of the cup and its rim, the former building up the retina, the latter actively participating in the formation of the ciliary body and the iris. The rim of the cup becomes skin and undergoes a considerable surface growth, squeezing itself in between the cornea and the anterior surface of the lens, where it leaves a small opening—the pupil. In this layer, as in the external layer, pigment becomes deposited, which becomes the pigmented layer of the iris. The adjoining layer of the mesenchyma furnishes the muscular and connective-tissue stroma of the iris. See, also, Vol. V, p. 3894 of this *Encyclopedia.*

Iris-diaphragm. In *optics,* a diaphragm or stop whose aperture is rendered mechanically variable in diameter. It is chiefly employed in photographic cameras, in order that a larger opening may be used when it is desired or necessary to admit abundant light, and that a smaller opening shall be available when greater sharpness of detail is sought. See also **Aperture.**—(C. F. P.)

An iris-diaphragm is sometimes employed in ophthalmoscopic and retinoscopic examinations for the purpose of regulating the amount of light to be thrown into the patient's eye. For the purpose of modifying the amount of light thrown into the eye when making a retinoscopic examination, Rhoads (*Amer. Jour. of Ophth.*, Jan., 1911) advocates the use of a retinoscope fitted with an iris-diaphragm. This can be adjusted so as to diminish the diameter of the mirror to fifteen or even ten mm. In addition to the diaphragm, the mirror is colored amethyst, yellow, or smoked, these colored rays being less irritating both to the observer's and observed eye. By this method Rhoads claims a distinct advantage in estimating the refraction of presbyopes, and young children.

Iris, Dislocation of the. Backward dislocation of the iris occurs in

cases of partial or complete rupture of the annular ligament of the ciliary body. See **Iris, Injuries of the.**

Iris, Ectropion of the. A congenital condition in which chocolate-brown masses, composed of from one to ten nodules, project from the margin of the pupil onto the margin of the iris. They are composed of uveal pigment, which may become detached and float in the aqueous humor. The affection has been incorrectly called papilloma of the iris.

In addition to the matter found on p. 4146, Vol. VI of this *Encyclopedia* it may be said here that Siegrist believes this condition to be due to active proliferation and migration of the pigment epithelium on to the anterior surface of the iris; the exciting cause of this process being the disturbances of nutrition which result from severe disease of the uvea. On the other hand, Meyer (*Arch. f. Augenheil.*, V. 73, p. 16, 1913) takes the view that ectropium uveæ is due to the action of an exudate which has undergone contraction, and in which the head of the ectropionized pigment layer is imbedded. The change is also favored by the shrinking of all the iris tissues and above all by the development in the anterior layers of the iris of new connective tissue, which exerts tension on the pupillary margin.—(C. P. S.)

Iris, Essential atrophy of the. Although this term was at one time thought to designate some particular form of iridic degeneration we now know that it covers and includes a number of quite different lesions. The lightest degree of tissue loss in the iris is seen in the diffuse atrophy which underlies the so-called heterochromia; more pronounced phases may be the sequel of various types of inflammation, as this occurs in recurring iritis and infective iridocyclitis.

A more common variety of iris atrophy arises in consequence of increase of intraocular tension, and depends upon compression of the blood vessels at the root of the iris, and perhaps upon compression of the ciliary nerves. Other frequently encountered types of iris atrophy follow rupture of the vessels which run from the major arterial circle, as, for example, in iridodialysis, or traction of the iris tissue, for instance, after its incarceration in corneal scars. Local iris atrophies are caused by the absorption of tuberculous and syphilitic lesions, or they may develop in the neighborhood of synechiæ; more diffuse atrophies occur in connection with siderosis, and extensive, even total ones after traumatic hemorrhage. Should the atrophy be circumscribed and the stroma pigment be destroyed, light and even white spots occur, and if they are numerous the condition develops which has been described under the name *vitiligo iridis.* A still further progress of this spotty atrophy consists in a loss of its stroma, so that

the retinal pigment layer is exposed, and if this too is destroyed, gap-formation is evident.

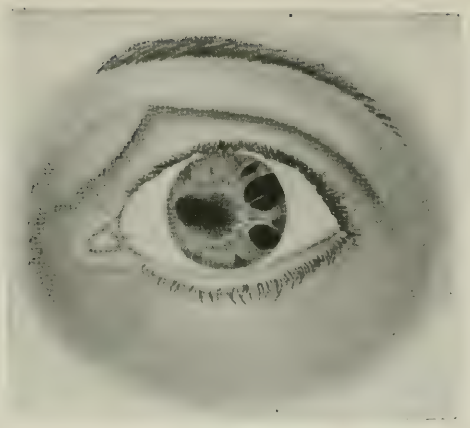
De Schweinitz (*Trans. Amer. Ophthal. Soc.*, Vol. XIV, p. 250, 1915) describes what appears to have been an essential progressive atrophy of all the layers of the iris, in an unmarried woman, twenty-three years of age. In March, 1912, she stated that for a month or more, certain changes had been noticed in the appearance of the left iris. She gave the history of having been in an automobile accident about nine years previously and had suffered much from the resulting shock. There was a slight proptosis of the left eye and the refractive error was corrected by —0.50 cyl. ax. 180°. The iris had the appearance of degeneration and thinning in spots, the pupil being egg-shaped, with its point up and in. There was a small gap at the extreme outer margin near the base. Five months later the pupil had become more ovoid, and a second fenestrum had formed above the first, and in five more months there was an increase in the size of all the holes and in the width of the pupil. A Wassermann test, about this time, was negative. The eye-ground contained no lesions, and the field of vision was perfectly normal. The iris at this time showed an oval pupil pointing slightly upward and inward, the entire iris thin, of a somewhat gray-blue color, and, on the outer side, extending to the limbus, two large and one small aperture, the largest of the three being crossed by a single strand of iris. Gradually the ovoid pupil previously described changed in shape and was more displaced, until it reached practically the margin of the nasal side and became vertically oval in shape. The three fenestra had in the meantime coalesced, and now had become one large gap, crossed by an irregular band of iris practically in the midline.

The first definite rise of tension occurred in April, 1914. The tension was tested with the finger. After three days' use of pilocarpin, 1/10 grain to the ounce, the finger tension became normal, and the pain which had accompanied the rise of tension subsided. One month later, for a period of two days the eye was blood-shot, and there was some pain over the brow and occiput. There was also a slight bulbar injection, but no synechiæ formed, and there was no failure of the distorted pupil to react to light. Again the finger tension was above normal and all the symptoms disappeared after a few days' use of pilocarpin and dionin. Curiously enough, a few days later a precisely similar flush appeared in the right eye, but there was no rise of tension, and during this period of time there was no fundus change, and the disc and vascular distribution in the retina were perfectly normal.

During the month of January, 1915, although finger palpation appeared to indicate a slight rise in tension, the tonometric measurement was never above 25. During the following three months several slight scleral flushes were evident, unassociated with the discoloration of the iris or the formation of synechiæ, and on one of these occasions this flushing of the sclera, not, however, localized in the ciliary zone, lasted for a week, and during this period of time there was slight nausea and vomiting. In June, 1915, when the last examination was made, the tonometer tension was 21, but the patient had used continuously for a long period of time a weak solution of pilocarpin. The right eye had a grayish-blue iris, with a distinct tinge of yellow in the minor circle. In the left eye and those portions of the iris remaining a slight tremulousness on motion was noticeable, and the edge of the lens could be distinctly seen. The color of the strands of iris which still exist is more gray than blue, and the yellowish tinge is greater than in the other eye. The inner nasal opening, which represents the original pupil, is surrounded by a yellowish border which constitutes the remnant of the minor circle, and there is a well-marked band of ectropion of uveal pigment. This pupil exhibits in diminished degree the usual reactions. The vision at this time was: O. D. + 0.50 cyl., ax. 150° = $^6/_5$; O. S. — 1. sph. ⌒ — 1.25 cyl., ax. 150° = $^6/_9$.

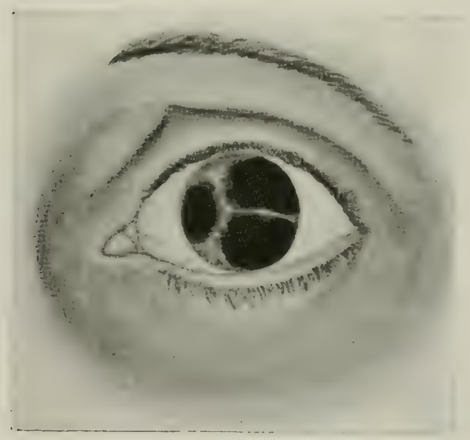
The visual field was not far from normal for colors, with a slight concentric contraction on both sides, but a little greater on the left side, and with the contraction slightly more pronounced on the nasal half than elsewhere. "There is no cupping of the disc and no pulsation of the vessels, and the flushings of the sclera previously described have not been repeated. The patient's general condition is very good, and since the last glasses have been adjusted, the headaches from which she suffered from time to time have practically disappeared." De Schweinitz thinks it hardly possible that the automobile accident which occurred long before the iris atrophy began, has any relationship to this progressive disappearance of the iris stroma. The general examination indicated very definitely the presence of a latent tuberculous infection and almost certainly a gastro-intestinal intoxication with a degraded nervous control. This would furnish a probable constitutional basis for the condition. As a far-fetched theory, it may be suggested that there is some fault in the secretion of ductless glands. The exact or even likely cause of the condition, however, is not yet discovered.

A somewhat similar condition of progressive primary atrophy and almost complete disappearance of the iris was reported by Casey



Appearance of iris July 9, 1913.

Appearance of iris January 22, 1915.



Appearance of iris May 5, 1915.

Progressive Essential Atrophy of the Iris. (De Schweinitz.)

Wood (*Ophthalmoscope,* Vol. VIII, No. 12, 1910). The patient, a man aged forty-four, had sustained a fracture of the right superior maxilla in 1891. Seven years later exploration of the antrum disclosed pus which was attributed to influenza and not to the previous injury. The atrophy of the iris began in 1904, and first manifested itself in what appeared to be a gradual enlargement of the pupil, eventuating in a gradual disappearance of the iris. These phenomena were watched until 1909, and there was a steady progressive disappearance of the iris stroma, unaccompanied by any symptom except increase of tension. It should be noted, however, that the patient had previously suffered occasionally from photophobia and wore smoked glasses. By the beginning of 1909 fully 5/6 of the iris tissue had disappeared, and the pupil had assumed the shape of an irregular triangle. The absorption of the iris tissue began on the anterior surface; gradually glaucoma developed, and the visual field, originally normal in extent, began to contract. Cyclodialysis and miotics furnished no relief. Toward the end of 1909 the eye was so painful and congested that it was removed. The eye was subsequently examined and the findings summarized thus: Subacute and chronic fibrinoplastic iridocyclitis; secondary glaucoma; extensive secondary atrophy of the entire iris. The glaucoma which usually develops toward the end of this process is, Wood thinks, probably an incident in the disease, and depends upon an effort of the eye to rid itself of the irritating products of the primary affection.

Zentmayer (*Trans. Coll. Phys.,* Phila., V. 35, p. 456, 1913) reports the case of a woman of 27, who 11 months before noticed that the dark part of her left eye was increasing, and six months later she began to see double. There was no history of trauma or inflammation. Fisher, who had examined the eye two months before the patient noticed the change in its appearance, had observed degeneration and thinning of the iris with an ovoid pupil and one fenestrum; and these changes progressively increased. When seen by Zentmayer, the point of the ovoid pupil reached to 1.5 mm. from the corneal margin. There were a half dozen fenestra, and through some of them the suspensory fibers of the lens were visible. The pupil still reacted to light and there was doubtful increase of intraocular tension. In seven months the nasal third of the iris had disappeared, except the sphincter and a few strands. The fundus and the other eye remained normal.—(C. P. S.) See, also, **Iris, Atrophy of the**; and **Iris, Exfoliation of the.**

Iris, Eversion of the. This is of very rare occurrence, but few cases having been recorded. Gelpke was the first to call attention to trau-

matic coloboma of the pigment epithelium of the iris. In a case reported by Praun, the only result of a contusion of the eyeball by a piece of wood, was the eversion of the torn off piece of the pigment layer of the iris through the pupil. This folded flap looked like a carpet hung out of a window. Hack (*Arch. of Ophthal.*, Vol. 42, No. 2, 1913) reports a case in which fifteen years previously the eye was injured by a blade of straw perforating the cornea and iris, reaching as far as the pigment layer. This layer was thereby separated from its underlying structure, and the pigment strip being fixed at the pupillary margin, was then everted through the pupil and projected free into the anterior chamber. The eye was completely free from irritation, and the tension normal.

Iris, Exfoliation of the. This condition, which is rarely seen, involves the anterior layer of the iris. A case is described by Jackson in which each iris was divisible into two zones: an upper, where the color was blue-gray, such as is seen in early infancy; and a lower, which presented a gray-brown color, the stroma of the iris being seen indistinctly. Between the zones was an irregular strip in which the anterior layer of the iris was hanging in shreds. It is supposed that the change in color in this affection is always from brown to blue or gray. Such eyes are particularly liable to glaucoma and cataract. See, also, **Iris, Essential atrophy of the.**

Irisfarbe. (G.) Color of the iris.

Iris, Filaria of the. This disease is rarely seen in this country, but among Orientals the filaria has occasionally been found in the anterior chamber or iris. See p. 5195, Vol. VII, of this *Encyclopedia;* as well as **Parasites, Ocular.**

Iris forceps. The variants of the well known and common form of this

Kuhnt's Double Curved Iris Forceps.

instrument [see **Forceps**; **Cataract, Senile**; and **Iridectomy**] are numerous. One of the rarer forms is here depicted.

Iris, Foreign bodies in the. Fragments of iron, steel, wood, glass, powder-grains, etc., may occasionally become impacted in the iris after perforating the cornea. They may move with the movements of the eye, or may remain imbedded in the stroma of the iris. Rarely

a cilium may be forced into the iris. A piece of steel or stone may rest in contact with the iris for a long time before causing inflammatory symptoms, but pieces of copper, even if aseptic, cause inflammation by chemic action. Foreign bodies in contact with the iris are easily detected unless the anterior chamber is filled with blood or exudate. They should be removed through a broad corneal incision, or, when possible, withdrawn by a magnet. If the substance is lodged in the iris, it can be removed by an iridectomy. Powder-grains when driven into the iris, should be allowed to remain and the eye should be treated with atropin. Siderosis may follow the prolonged lodgment of pieces of iron or steel in the iris. See, also, **Iris, Injuries of the**; and **Injuries of the eye.**

Irisgefässe. (G.) Blood vessels of the iris.

Iris, Granuloma of the. TUBERCULOSIS OF THE IRIS. The tubercular nature of these solitary growths was first demonstrated by Haab. See **Iris, Tuberculosis of the.** On the other hand, after operations on the iris, or following wounds, granulomata may appear on the surface of the iridic tissue. This condition was more often referred to by older writers than it is at the present day. It is also occasionally seen as a development after perforating ulcer of the cornea, the mass filling the perforation being composed of iris tissue and granulation tissue springing from the iris. See, also, **Injuries of the eye** under the subtitle *Foreign bodies in the iris.*

Iris, Gumma of the. Gummata appear in the later secondary stage of syphilis, the clinical signs of which are peculiar to this condition. In rare instances gummata are found in infants with hereditary syphilis. The iris shows one or more yellowish-brown or reddish-brown nodules, varying in size from a pin's head to a pea. They are seen at the ciliary or pupillary border, or midway between the two, and are often crossed by vessels. Although found in the secondary stages of syphilis, the name gummata has been applied to them. They soon disappear under treatment without leaving scars in the iridic tissues. Some authors apply the term *iritis papulosa* to this condition, and reserve the name gummatous iritis for those cases of true gummata which appear later in the history of syphilis. See **Iritis**; also p. 5658, Vol. VII, of this *Encyclopedia.*

Irishäkchen. (G.) Iris hook.

Iris, Hernia of the. See **Hernia of the iris.**

Iris, Herpes of the. Iritis frequently results from herpes corneæ; iritis and iridocyclitis may also result from herpes in another part of the body. Herpes of the iris, however, is but rarely encountered. Gilbert (*Klin. Monatsbl. f. Augenh.*, I, p. 649, 1911) describes a case

of herpes in the cornea, in which, in the fifth week of the corneal disease, a herpetic eruption of the iris developed, preceded by severe pain. Its chief characteristics were a marked swelling of the pupillary part of the iris and a little later hemorrhage from the iris, followed by reduction in the swelling. In a second instance, although less completely under observation, the course of the disease was apparently similar. In a third case the corneal herpes was complicated by hypopyon as well as an iritis marked by swelling and a small hemorrhage. The author concludes that the characteristics of actual herpes of the iris, as distinguished from iris irritation accompanying herpes zoster and febrilis, are swelling of the pupillary part of the iris and subsequent hemorrhage into the anterior chamber.

Iris, Heterochromia of the. This is congenital when one iris presents from infancy a color different from that of the other. It may be symmetrical, or one part of the iris may be markedly darker than the remainder. Small pigment spots in the iris may be mistaken for foreign bodies by an inexperienced examiner. See **Heterochromia**; as well as **Iris, Anomalies of the,** and **Congenital anomalies of the eye.**

Iris, Hypernephroma of the. See **Iris, Tumors of the**; also **Hypernephroma.**

Iris, Hyperplasia of the. Increase in certain iridian tissues. In an eye enucleated for choroidal sarcoma, Alt (*Amer. Jour. Ophthal.*, 28, p. 328, 1912) found, in addition to the growth, decided thickening of the pigment layers of the iris, especially at or near the pupillary margin. The thickening resembled a nevus or melanoma. Microscopically, the growth was made up of epithelial cells growing backwards into the posterior chamber. While there were nowhere any signs of posterior synechiæ, it is impossible to say positively that this was not the origin of the new formation.

Iris, Hypoplasia of the. See **Iris, Aplasia of the.**

Iris illuminator. An attachment (devised by R. H. Ward) for the microscope. It is used with oblique as well as with axial illumination. It consists of a slit diaphragm mounted under the object glass, with a decentering screw.

Iris, Implantation cysts of the. See **Iris, Cysts of the,** as well as **Cyst of the iris.**

Iris-inaction test. A synonym of the Wernicke or Wilbrand hemianoptic pupil test. See **Hemiopia**; as well as Vol. VII, p. 4621 of this *Encyclopedia*.

Iris, Incarceration of the. Following cataract extraction, or after accidental injury, the iris may protrude through, or be caught in,

the lips of a corneal wound. The diagnosis of this condition is easily made by inspection. See **Hernia of the iris.**

Iris, Inflammation of the. See **Iritis.**

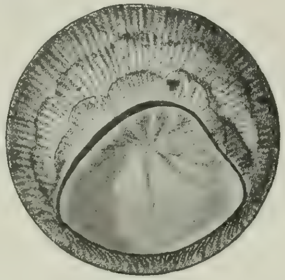
Iris, Injuries of the. The iris is subject to various injuries, but, on account of its protected position, these injuries are generally accompanied by more or less damage to other tissues. It often happens, however, that the injury to the iris is of greater moment than is that of other parts. See **Injuries of the eye**; also, **Iridodialysis.**

Iris, Intraocular reposition of the. After operations, particularly for cataract with the lance-knife, especially when the operation is consecutive to a preliminary discission or is done for traumatic cataract, so that the iris is more or less injured and hard to replace, it occasionally happens that after reestablishment of the anterior chamber the iris in the vicinity of the extraction wound is covered by delicate cataractous remains or by fibrin, or that a fine strand of capsule is drawn over the pupillary margin to the corneal wound. The last-named accident also occurs very rarely after discission of after-cataract. In any case the result may be a slowly progressive narrowing of the affected part of the iris, so that after the lapse of three or four weeks the pupil is drawn up to the corneal wound.

This shrinking of the iris may easily be overcome by the following operation, as suggested by Elschnig (*Klin. Monatsbl. f. Augenh.*, V. 54, p. 186, 1915). Suppose the iris is drawn upwards. The smallest of the three Knapp knives is carried from the lateral limbus (entering subconjunctivally) into the anterior chamber, parallel to the iris surface, the edge facing towards the lower angle of the anterior chamber. The tissue which covers the anterior surface of the iris, or the tissue which adheres to the iris, or the incarcerated capsule, or the scar tissue including the superficial layers of the iris stroma, as the case may render necessary, is caught up and divided with the point of the knife. The result of the procedure is usually surprising, and it is permanent. Elschnig has employed it five times in the course of three years. In four instances the pupil became and remained perfectly central and round, and in the fifth case it remained slightly drawn up. The operation was done at the earliest twelve days, and at the latest five weeks, after the operation which led to the displacement of the iris.—(Abstract from *Ophthalmic Literature,* Sept., 1915).

Iris, Inversion of the. This is a rare condition due to trauma, and has not been satisfactorily explained as to its mechanics. The iris is

turned backward and is doubled upon the ciliary body. The condition may be partial or complete. There is often an accompanying dislocation of the lens, and with it hemorrhage into the aqueous and vitreous chambers. When the condition is total, absolutely no iris is to be seen. The treatment is entirely symtomatic. After the eye has become quiet attention should be directed to the refraction. See, also, **Injuries of the eye.**



Partial Inversion of Iris. (Würdemann.)

Irisitis. (L.) An unused synonym of iritis.

Iris, Laceration of sphincter of the. See **Injuries of the eye.**

Iris, Leiomyoma of the. This rare variety of tumor, formed of smooth muscular fibres as a fundamental element, has been noted by van Duyse and Baivy (*Bull. de la Soc. Belge d'Opht.,* No. 29, p. 140, 1911).

Iris, Leprosy of the. The iris is often attacked in ocular leprosy, especially where the infiltration has begun in the corneal margin. Nodules form in the iris angle, partially obliterating the anterior chamber. Less often, a single nodule is present, but seldom is on or near the edge of the iris. The whole iris tissue becomes softened by a chronic inflammatory process. There is a deposit of fibrin, which occludes the pupil. See **Leprosy**; also **Tumors of the eye.**

Iris, Lipoma of the. See **Iris, Tumors of the.**

Iris, Lymphoma of the. Among the more unusual forms of tumor seen in the iris, lymphomata are found in cases of splenic leukemia. The growths may be situated superficially or deeply in the iris-tissue. When superficial, they are present as multiple, gray, transparent nodules surrounded by a vascular net-work. When deeply placed they cannot be seen, but their presence should be suspected because of chronic iritis with pupillary exudate and vitreous opacities. They do not suppurate. They may be confounded with gummata. The disease is found chiefly in young persons, and it precedes the general manifestations of leukemia. Microscopic examination shows a mass

of leucocytes in the stroma of the iris, dense, and presenting vessels gorged with white corpuscles. In benign forms the neoplasm may entirely disappear, leaving the iris partially discolored and atrophic. Grave cases end in total atrophy of the globe. Aside from the use of atropin, local treatment is not indicated in these cases.—(J. M. B.) See, also, **Iris, Tumors of the.**

Irismangel. (G.) Absence of the iris.

Iris, Melanoma of the. A congenital proliferation of the pigment-cells of the iris-stroma, forming a small, dark growth which may be the starting point of a melanotic sarcoma. It is a rare condition. See **Iris, Tumors of the.**

Iris, Myomata of the. See **Iris, Tumors of the.**

Iris, Myosarcomata of the. See **Iris, Tumors of the.**

Iris, Nerves of the. See **Anatomy of the eye**; as well as **Histology of the eye.**

Iris, Nevus of the. This vascular tumor is occasionally seen as a small, dark, lobulated growth, springing from the iris and bleeding spontaneously. In some cases these growths are associated with multiple nevi scattered over the whole body. Vascular iridal tumors may be mistaken for sarcomata. They should be removed by making a broad iridectomy. See **Iris, Tumors of the.**

Irisol. A proprietary disinfectant mixture containing iodoform (50 per cent.) and boric acid (45 per cent.).

Irisopsia. Visual defect in which objects appear surrounded by rings of colored light.

Iris, Papilloma of the. See **Iris, Tumors of the.**

Iris, Pearl-cysts of the. See **Iris, Cysts of the**; as well as **Cyst of the iris,** and **Iris, Tumors of the.**

Iris, Pigment of the. The pigment varies in situation in different irides. In light-colored eyes the only pigment is that found on the posterior surface of the iris. This layer is absent in albinos. In dark eyes pigment-granules are found in the stroma of the iris and in the cells of the anterior surface in addition to the posterior layer. The posterior layer, called the retinal part of the iris, is made up of pigment-cells and is a continuation of the pigmentary layer of the retina, which consists of two layers of pigment. These pass forward in a wavy course to the pupillary edge of the iris, where they unite. This layer turns slightly forward at the pupillary margin. Harman (*Trans. Ophth. Soc. Unit. King.,* Vol. 34, p. 137) observed the pigment in the irides of children, the offspring of a blue-eyed, fair-haired father and a brown-eyed, dark-haired mother. At birth, in each case, the irides were of the usual dull slatey-blue color, and the iris tissues were

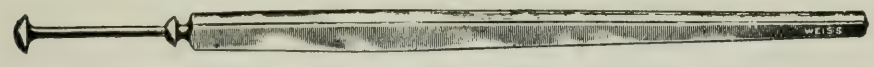
obscured as though coated with some fine-textured material. Clearing of the iris stroma was noted from the third to the sixth week of life. Two children developed blue eyes, one blue with a suggestion of violet, due to rims of finer dark stroma at the margins. The other blue became bright and cold in tint, owing to a marked thickening of the stroma in the intermediate zone. Two children developed brown irides. The first sign of brown pigment was noted at the sixth week. The pigment was in broad irregular patches extending from the basal margin. The development was earliest in the temporal half of the iris. The patches extended and fused until the whole was brown. The tint became full and pure in one child; in the other there remained at the age of two years some suggestion of bluish or greenish tint in the depth of the crypts of the iris.—(C. P. S.) See, also, **Iris.**

Irispincetten. (G.) Iris forceps.

Iris, Prolapse of the. See **Hernia of the Iris; Cataract, Senile;** as well as **Injuries of the eye.**

Iris, Pupillary membrane of the. See **Iris, Anomalies of the;** also **Congenital anomalies of the eye.**

Iris repositor. Instruments for replacing a prolapsed iris are described under **Cataract, Senile,** and elsewhere in this *Encyclopedia.* Here is



Iris Repositor of Cridland, to Replace Iris by External Stroking Over the Limbus and Cornea.

depicted one devised by Cridland (*Ophthalmoscope,* X, p. 699, 1911). The inventor claims that it is very successful in smoothing the iris into place when applied over the limbus and cornea. The button that forms the tip of the repositor is hemispherical, and is 5 mm. in diameter.

Iris, Retention cysts of the. See **Iris, Cysts of the,** as well as **Cyst of the iris.**

Iris, Retroflexion of the. See **Injuries of the eye.**

Iris, Retroversion of the. See **Injuries of the eye.**

Iris, Rupture of the. Iridodialysis. See **Injuries of the eye,** as well as **Iris, Injuries of the.**

Iris, Sarcoma of the. See **Iris, Tumors of the.**

Irisschlottern. (G.) Tremulous iris.

Iris, Serous cysts of the. See **Iris, Cysts of the,** as well as **Cyst of the iris.**

Iris snipper. The *Irisstanze* of Pagenstecher is employed to make a peripheral iridectomy after cataract extraction. The iris is replaced in the usual manner, after which the instrument—a diminutive scissors-punch—is passed into the anterior chamber, lightly pressed against the root of the iris and a small piece of the membrane snipped or cut out.

Pagenstecher's Irisstanze, or Iris Snipper.

Iris spatula. See **Iridectomy.**

Iris, Sphincter of the. See **Iris**; as well as **Anatomy of the eye.**

Iris, Spontaneous absorption of the. See **Iris, Atrophy of the.**

Iris, Sporotrichosis of the. One case has been seen by Jeanselme and Poulard. See **Sporotrichosis.**

Iris, Tears of the. See **Iris, Injuries of the.**

Iris, Total prolapse of the. See **Injuries of the eye.**

Iris, Transfixion of the. See **Iris bombé.**

Iris, Translucency of the. In order to determine the differences in translucency between normal and cataractous eyes Rubel (Graefe's *Archiv für Ophthalmologie,* 1913, LXXXII, p. 317) made some experiments with the Sachs lamp. The translucency of the normal iris depends mainly on the nature and structure of the stroma. Both the pigment content and the anterior layer are of first importance. No material or direct influence is to be ascribed to the pigment epithelium. No difference of brightness in favor of the upper or lower half of the iris could be perceived. The senile atrophy of the stroma, seen clinically, has no influence on the transparency of the iris. The translucency often increases in cataractous eyes, without any explanation being discoverable in the nature and pigment content of the anterior layer. It depends on a senile atrophy of the central and peripheral parts of the retinal pigment layer, which proceeds hand in hand with the maturity of the cataract. When there is abnormal transparency, complications on the part of the vitreous are to be feared in cataract extraction. In such eyes the vitreous is often fluid. See, also, p. 3945, Vol. V, of this *Encyclopedia.*

Iris, Tremulous. See **Iris, Motor disturbances of the**; also, **Iridodonesis.**

Iris, Tuberculosis of the. This disease is well understood, and it can be produced experimentally. It is observed in children and young people. It occurs both as disseminated (miliary) tuberculosis and as solitary tubercles—i. e., either in the form of small nodules or as a larger

growth resembling a neoplasm. In both instances it is secondary to deposits elsewhere. In the milder cases recovery may take place, while in severe cases the eye is usually lost. It has been shown that tuberculous iritis can be set up by the introduction of tuberculous masses into the anterior chamber. In twenty to thirty days afterwards the eye becomes red and the phenomena of iritis make their appearance; at the same time gray nodules are noticed in the iris. These increase in number, become confluent, afterward fill the anterior chamber, and finally break their way through to the outside. The solitary tubercle, as so far observed, is confined to one eye. It either develops simultaneously with the miliary nodules, or, more frequently, without them, and without any symptoms of iritis, so that it resembles a neoplasm; indeed, it was at first described as such by von Graefe, under the name of *granuloma*, because Virchow, who made the anatomical examination of the tumor, described it as granulation tissue. Its subsequent course seems at first to confirm the diagnosis of a neoplasm, since the tumor keeps steadily enlarging, and finally, perforating the cornea near its margin, pushes out in the form of an exuberant growth. But then, instead of a larger tumor developing from this, which keeps growing on indefinitely, the growth breaks down, so that ultimately nothing is left of the eyeball but an atrophic stump. Haab was the first to bring proof of the fact that these tumors, formerly designated as granulomata, are tubercles (Fuchs). Somewhat resembling tuberculosis, is that affection produced by the entry of caterpillar-hairs into the conjunctival sac, and known as *ophthalmia nodosa*, and *nodular keratitis*. Some weeks or months later, nodules develop with violent inflammatory symptoms in the iris. Examination of the excised nodules reveals the presence of caterpillar hairs.

Treatment consists, in addition to various local agents applicable to all forms of iritis, of special systemic treatment of the tuberculosis, and injections of tuberculin. Injections of new tuberculin, beginning with a dose that will not set up either a local or a general reaction, and gradually increasing the dose, is the method recommended by Fuchs. The introduction of iodoform into the anterior chamber has been advised, both as an oily emulsion and in the form of Haab's rods. Failing these remedies, and especialy if the ciliary body and choroid are involved, enucleation may be necessary, that it may not be the source of a further extension of the tuberculosis.—(C. P. S.) See, also, **Iritis**; and **Tuberculosis of the eye.**

Iristuberkulose. (G.) Tuberculosis of the iris.

Iris, Tumors of the. *Serous cysts* occur, very rarely, in the iris. They develop in the stroma of the iris, their walls being formed by rarefied

iris tissue, showing some pigment. They are filled with a clear substance. Serous cysts develop after penetration of the eyeball, and grow very gradually until they reach the posterior surface of the cornea, and fill half or more than half of the anterior chamber. They then flatten out upon the cornea which becomes cloudy at the point of apposition. Meanwhile the cyst has reached the pupillary margin of the iris and pushes it forward into the pupil so that the latter becomes kidney-shaped and afterward reduced to a mere slit. Moreover, the cyst keeps extending backward, too, and this causes tilting and opacity of the lens. Elevation of tension supervenes, resulting eventually in blindness. Cases of congenital cysts have been observed; also cases of *pearl cysts,* which are distinguished from the serous cysts by their contents which are pultaceous, tallowy, or like gruel; in rare cases hairs are also found in them. The pultaceous contents of the pearl cysts are formed by the epithelial cells which are constantly thrown off from the inner surface and undergo fatty disintegration.

No certain explanation of the development of cysts (except the traumatic cysts) has been found. There are normally in the iris neither glands nor epithelium, so that retention cysts are out of the question. The epithelium must have gotten into the iris from outside. This can be understood when we consider that in the process of healing in wounds of the cornea, the epithelium on the surface usually grows rapidly down into the deeper parts. It sometimes happens that the epithelium extends beyond the inner orifice of the wound and into the interior of the eye. In that case it grows on along the walls of the anterior chamber and covers both the posterior surface of the cornea and the anterior surface of the iris. Such a formation of an epithelial lining for the anterior chamber, which may receive the name of an *anterior chamber cyst,* cannot be diagnosed clinically, since the epithelium is transparent; but it is very destructive to the eye, as it leads to increase of tension, because the epithelial lining hinders filtration through the sinus of the chamber. If the iris abuts on the posterior orifice of the wound, the epithelium as it grows into the deeper parts gets into it. It pushes the layers of the iris farther and farther apart and develops into an iris cyst (Stölting).

Tertsch (*Ophthalmology,* Vol. II, p. 145, 1913) distinguishes three kinds of spontaneous cysts of the iris: 1. Cysts due to cystoid conversion of endothelial and epithelial cells, implanted in the stroma of the iris, or to cystic expansion of cavities in the stroma of the iris. These cysts lie in the stroma of the iris, being everywhere surrounded by iris tissue. All cases belonging to this class were located at the anterior surface of the iris. 2. Cysts created by expansion of a pre-

formed cystoid space at the posterior surface of the iris, produced by adhesions of the ciliary processes, persisting at the posterior surface of the iris. The wall of these cysts is formed mostly by the tissue of the ciliary process, for the smaller part from the iris. They are situated outside of the stroma of the iris, and grow forward or backward, or equally in both directions. 3. Intraepithelial cysts lie between both layers of the pigment epithelium of the iris and extend forward or backward into the posterior chamber.

Pseudo-cysts may be produced in the anterior chamber by adhesions between the iris and cornea; or in the posterior chamber by adhesions between the iris and lens. These sacculated portions dilate from the accumulation of liquid in them.

Cysticercus vesicles are occasionally observed in the anterior chamber. They may lie free in the aqueous, or they may be attached to the anterior surface of the iris.

Cysts of the iris must be removed early to prevent blindness. This is done by making an incision at the margin of the cornea at a point corresponding to the cyst; the forceps is entered through the incision, and the cyst together with the adjoining iris is drawn out and excised. Often a complete removal is not possible, in which case a recurrence of the cyst is to be expected.

Melanomata occur in the iris. These are benign tumors and are found under two forms. The first consists in the outgrowth of a blackish tumor from the stroma of the iris into the anterior chamber. It arises from the proliferation of the pigmented stroma of the iris. The second form has its seat at the pupillary margin of the iris. It develops from the cells of the retinal pigment layer at the spot where it is reflected upon the anterior surface of the iris at the edge of the pupil. Here small blackish-brown nodules develop which project into the pupil. Sometimes, in consequence of the alternating movements of the pupil, they become separated from the pupillary margin and then lie free in the anterior chamber. Both of these forms of melanoma are benign tumors which reach only a certain size. Nevertheless, cases are known in which pigmented sarcomata have afterward developed from the first variety of melanomata.

Among the pigmented tumors, pigmented sarcomata and melanomata of the first kind resemble each other closely. They can be distinguished with certainty only by determining from the previous history, or from observation, whether a process of growth is going on or not.

Sarcoma is rare in the iris. Most of the cases reported have been melanosarcomata arising from nevi pigmentosi in persons past the thirtieth year, although the disease has been observed as early as the

second year, by Alt, and as late as the seventy-fifth year, by Zellweger. In about 25 per cent. of the cases the growth is a lymphsarcoma. The tumor usually consists of spindle cells, some pigmented, others not, arising chiefly from the anterior layers of the iris. It increases by growth of the stroma or adventitious cells, fills the anterior chamber, and involves the ciliary body. The most noticeable of the early symptoms is the presence of a growing tumor, which is usually pigmented. It may exist for months or even years before causing inflammatory symptoms, or before interfering with the movements of the iris. The tumor is often vascular and nodular. It may cause hemorrhages into the anterior chamber. The lens becomes displaced, the tension increased, iritis develops, and the eye becomes blind.

Laven (*Klin. Monatsb. f. Augenhl.*, Oct., 1913) describes the microscopic appearance of a primary sarcoma of the iris, occurring in a girl of 12 years. The tumor had developed on the basis of a pigmented nevus of long standing. After enucleation of the eyeball, 21 months had so far elapsed without metastasis or orbital recurrence. There was a ring-shaped distribution of the growth in the region of the root of the iris. The tumor had taken origin in the iris stroma. Statistical consideration of thirteen cases of primary iris sarcoma described in the literature indicates a relative benignity of this class of growth, at least as regards length of life; but there is a marked tendency to recurrence or metastasis. After excision by way of iridectomy, there were five cases of relapse in the eyeball. Two of these remained free from further relapse after enucleation, and one after multiple cauterization. In one case enucleation was done 11 years after excision of the tumor, and death followed 6 years later from general metastases. Orbital metastases occurred in two cases after enucleation. In six cases metastases in distant organs occurred without orbital recurrence.

Groenouw (*Centralbl. f. pkt. Augenheilk.*, p. 101, 1908) describes the left eye of a man, aged 41, that presented, in the lower temporal sinus, a brown tumor of the iris, 6 mm. long, 3 mm. wide, without other changes of the iris. The refracting media were clear, the optic nerve excavated, vision reduced to perception of light. The patient had noticed the tumor twenty-two years before, when it had exactly the same dimensions, according to the records of the ophthalmic surgeon, and vision with a cylinder, = 6/v. It could not be ascertained whether the tumor had existed even longer, perhaps from birth on. It caused no disturbances until five years before, when the eye gradually grew blind without inflammatory symptoms.

From similar cases from literature, Groenouw considered it either

as a very slowly growing melanosarcoma or as a melanoma existing over twenty years which became sarcomatous within the last few years. Most likely an early removal of the tumor by iridectomy would, on account of its benign character, have effected a cure with preservation of sight, although, in general, enucleation of the eyeball is given preference by various authors, as sometimes, besides the original tumor, metastatic nodules may occur in the iris, which remain after iridectomy and cause relapses. As pointed out by Wood and Pusey (*Arch. of Ophthal.*, Vol. 31, No. 4, 1902) it is important to note and draw the attention of patients to suspicious "spots" on the iris, since a certain percentage of these develop malignant characters.

The following conclusions are drawn by E. V. L. Brown (*Jour. Am. Med. Ass.*, Aug. 11, 1906) on the basis of clinical and histologic studies:

1. Ribbert's theory of the origin of all uveal sarcomata from chromatophores is worthy of careful consideration.

2. The analogy between the round-, spindle- and star-shaped cells in these malignant growths and the spindle- and star-shaped cells found in the embryonic choroid is incomplete, as a round-cell first stage has not been proved to be present in the latter.

3. It is more reasonable to suppose that the cell reversion takes place to any one of these forms of sarcoma analogous to the relations which obtain between embryonal and pathologic conditions in glioma, than it is to suppose that lower-cell forms are transformed into higher.

4. So-called leucosarcoma of the iris offers a more favorable opportunity for the study of the chromatophore theory than does sarcoma of the choroid, because here the normal chromatophore is much less heavily pigmented than in the normal choroid, or than the chromatophore in the iris. Pressure, too, destroys the normal cell.

5. The term leucosarcoma should be retained, but used only in reference to the clinical appearance of iris sarcoma.

Vascular tumors of the iris have been seen a few times as dark, lobulated growths, springing from the iris and bleeding spontaneously. They may be associated with multiple nevi scattered over the whole body. Vascular iridal tumors are likely to be mistaken for sarcomata. They should be removed by making a broad iridectomy.

Tubercles, nodules, papules and *gummata*, as clinical manifestations, have been described under **Iritis.**

Among tumors of very rare occurrence may be mentioned *myomata* (Lagrange); *leiomyomata* (van Duyse and Baivy); *myosarcomata* (de Wecker and Ivanoff, Breschfeld, Deutschmann) springing from the ciliary muscle; *epithelial growths* resembling adenoma and carcinoma, originating from the cylindrical cells of the pars ciliaris

retinæ (Badel, Lagrange, Lawford, etc.); *metastatic carcinoma* (Uhthoff); *hypernephroma* (Ball); and lastly *lepra nodules* (Bull and Hansen).

The differential diagnosis of tumors of the iris sometimes presents difficulties. A non-pigmented nodular tumor of the iris may be a syphilitic growth or a solitary tubercle, an unpigmented sarcoma, or a granulation tumor which has formed around a foreign body imbedded in the iris. The distinguishing marks are as follows:

(1) The granulation tumors contain most vessels and are hence usually reddish. The vascularity of sarcomata varies, but is often quite considerable; the syphilitic growths have fewer, the tuberculous masses scarcely any, vessels passing through them. In the case of the tubercles, small, gray tuberculous nodules of characteristic appearance are sometimes found in the neighborhood of the large tumor.

(2) Papules of the iris are situated only at its pupillary and ciliary margins—never at other spots—while other tumors may take their origin from any point whatever on the surface of the iris.

(3) With syphilitic and tuberculous tumors, iritis appears earlier than with sarcomata.

(4) Tubercle is found, as a rule, in persons under twenty, while both the other kinds of tumors usually occur after that age.

(5) Particular importance must be attached to the general examination of the patient, with the purpose of determining whether there is any evidence pointing to the presence of a foreign body in the iris; or if signs of syphilis or tuberculosis are found in other organs. In doubtful cases it is justifiable to initiate an energetic mercurial treatment, from the result of which a conclusion may be drawn as to the nature of the tumor.

A contribution to our knowledge of iris tumors was made by Franke (*Arch. f. Ophth.*, April, 1909) who reported the following case: The patient, a woman of 50 years, had accidentally noticed the growth were the intercellular lymph spaces distended, giving the apanterior chamber and reached almost to the pupillary margin. Its surface was smooth and avascular. The pupillary border of the iris was attached to the capsule of the lens. The eye was free from injection. The tension was normal and vision was 1/3. After 4 weeks of ineffectual treatment enucleation was advised and on its rejection iridectomy was performed. After 2½ years there had been no recurrence.

Microscopically, there were various sized, polygonal cells of an epithelial character showing vesicular nuclei with beautifully developed granule bodies and chromatin net. The cells lay close to one another

without intercellular substance. Only in the peripheral parts of the growth two weeks previously. The tumor filled the angle of the pearance of a covering epithelium rich in fluids. The cell protoplasm was also rich in fluids giving in many places a honey-combed appearance to the new formation. The protoplasm was here in parts so liquefied that only the spongioplasm was retained; in other places there were cells with a small amount of protoplasm in the midst of large spaces. There was a quite richly developed, vascular net with which the above cells were in intimate association as though genetically connected with the vessel walls and having their origin from the perithelium. The isolated mitoses found in the perithelium also indicated this. Scattered throughout the growth were branching pigmented cells and free pigment. Together with the above were tumor giant-cells and voluminous tumor cells. Of true iris tissue there was but little present. A small sector was demarcated by pigment which might be mistaken for the remains of original pigment from pigment-cell development in the surrounding, scantily pigmented area. In this sector there was rich vascularity and pigment growth was going on about the vessels. The walls showed slight hyalin thickening. Throughout the tumor, in isolated vessels, there was heaping of round cells of lymphoid character.

A remarkable peculiarity of the growth was the central cavity, which taken with the fluidity of the protoplasm may be looked upon as a cystic softening similar to that observed in tumors of the external skin. There was a mucoid softening of the connective tissue parts surrounding the tumor, as the result of congestive edema.

The writer says that clinical experience demonstrates that the pure forms of peritheliomata are on the whole benign growths, and it is likely that tumors of this type in the iris may run a benign course. Because of this the author considers it important to separate pathologico-anatomically the different tumor types rather than to group them under one head. He considers the question of iridectomy versus enucleation still an open one.

Treatment. In view of the difficulties attending the diagnosis of iridal growths, it is advisable to operate upon them early, making a broad iridectomy which shall include all of the mass and a part of the healthy iris on each side. Then a microscopic examination can be made and the nature of the growth determined. If it proves to be a malignant growth, enucleation must be considered, though it may be advisable to wait for a time and to note the effect of the iridectomy. In a few cases not only has the eyeball been saved and useful vision preserved, but no recurrence has been noted for years after the operation.

The growth of an iris sarcoma is slow, and a period of at least three years must elapse before a case treated by iridectomy can be considered as cured. If vision is seriously affected, an immediate enucleation should be performed. If, after iridectomy, the growth shows signs of recurrence, the eye must be removed immediately.

Probably a more precise statement is that, if one desires to be *absolutely on the safe side,* enucleation followed by radiotherapy should always be resorted to when the tumor is definitely shown to be a sarcoma or other malignant neoplasm; iridectomy and expectant treatment *may* effect a cure but they subject the patient to serious danger to life.

Gonzalez (*Anal. de Oftal.,* June, 1912) reports successful treatment of a case of leproma of the iris by the use of X-rays. Cutaneous lepromata and ulcerative areas which were present were subjected to the X-rays at the same time, resulting in a diminution in the size of the tumors and cicatrization of all the ulcerated areas. Chaillons (*Ann. d'Ocul.,* Vol. 151, p. 461, 1913) successfully treated by electrolysis a large transparent cyst of the anterior chamber. He entered the positive pole needle at the limbus and a current of four milliamperes maintained for two minutes.—(C. P. S.) See, also, **Tumors of the eye**; as well as p. 3674, Vol. V of this *Encyclopedia.*

Iris, Veins of the. See **Iris**; as well as **Anatomy of the eye.**

Iris, Voluntary. This term is applied to those rare cases in which, without change of convergence or accommodation, the individual can contract and dilate the pupil at will. See the *bird's iris,* p. 982, Vol. II of this *Encyclopedia.*

Iriswinkel. (G.) Iris angle.

Iriswinkeleinschneidung. (G.) Incision of the iris angle.

Iris, Wounds of the. See **Iris, Injuries of the.**

Iriswurzel. (G.) Root of the iris.

Iritic. Pertaining to or of the nature of iritis.

Iritis. Iritis in general. Inflammation of the iris may be acute or chronic, congenital or acquired, idiopathic or traumatic, primary or secondary, simple or complicated.

Symptoms of Iritis.

Acute attacks usually set in with discomfort and aching in and around the eye, soon replaced by pain, due to irritation of the ciliary nerves. The pain is not only in the eye itself but radiates usually over the brow and sometimes down the cheek. As the disease advances the pain becomes worse. It is especially severe at night, keeping the patient awake, and in a short time becomes more or less constant.

In the early stages the eye is reddened, the injection of the vessels becoming more pronounced as the inflammation increases; particularly is this the case in the corneo-scleral margin (pericorneal zone) which, assuming a pinkish hue at first, soon becomes of a dusky-red color. At the same time the eyeball becomes sore and tender to the touch. When the iritis is fully developed the eyeball is exceedingly sensitive, probably due to involvement of the ciliary body whose blood supply is intimately connected with that of the iris. Lacrimation and photophobia are now prominent symptoms. Discoloration, loss of lustre and a swollen, muddy appearance of the iris surface are early manifestations of the inflammatory changes. A brown iris, for example, changes to yellow; a blue iris takes on a greenish hue, and so on.

The pupil becomes contracted and its usual reactions to light and accommodation are affected; slightly in mild cases, while it does not respond at all in the severe or pronounced cases. This defect in the normal expansion and contraction of the pupil may depend upon a number of causes: the engorgement of the iris vessels; spasm of the sphincter of the iris; exudates into the substance of the iris, or, as usually happens when improperly treated, adhesions that have formed with the anterior capsule of the lens.

Exudates are almost invariably present on the posterior and anterior surfaces and margins of the iris and are of a glue-like (plastic) consistency. This is what causes adhesions to form between the iris and lens (posterior synechia) and is the chief cause of blindness from iritis. The pupil is, thus, often bound down to the lens about its whole circumference (ring synechia, exclusion of the pupil) so that it becomes immovable; or adhesions take place at various points along the pupillary margin, causing the pupil to dilate and contract irregularly when exposed alternately to deep shadow and strong illumination. This irregular dilatation of the pupil is plainly shown when a mydriatic is instilled into the eye. Eventually the pupillary space may become covered with an exudate, and, if this be dense, vision is very seriously impaired. This condition is known as occlusion of the pupil.

In the early stages the synechiæ may be broken down by the prompt use of an effective mydriatic, such as sulphate of atropia. When these adhesions are thus detached, dots of brownish pigment are left on the anterior capsule in the locality where the adhesions had formed. Sometimes the synechiæ stretch as the pupil dilates, leaving a whitish thread or patch of exudate connecting the margin of the dilated pupil with the point of adhesion on the anterior lens capsule. The character of the exudate may also be serous or purulent. Vision is always more or less lowered—owing to cloudiness of the aqueous humor, deposits

on the lens capsule and cornea, or exudates into the pupil and even into the vitreous chamber. Interference with the focusing apparatus, due to congestion or inflammation of the ciliary body, is also one cause of a temporary interference with vision.

Occasionally attacks of iritis are encountered in which pain and redness are either absent or so slight as to pass unnoticed. In these instances impairment of sight is the only symptom complained of, although on examination synechiæ are found which have been gradually forming for some time. This form of disease is known as *quiet iritis.*

Pathology of Iritis.

The pathologic changes usually found in iritis are due to enlargement of the vessels both in length and caliber, displacement of the endothelium by a fibrinous exudate which permeates the iris stroma like a sponge, and often overflows into the anterior chamber and pupil, increased leucocytosis and, in some cases, hemorrhage, especially in septic iritis. The cells present in the exudate are lymphocytes, polymorphonuclear leucocytes, and mast cells.

Assuming that all forms of iritis, aside from that due to injury and local ocular infection, is a localization in the iris of a general malady, even if the systemic disease cannot be discovered, Terrien and Cantonnet (*Arch. d'Ophtal.,* May, 1907) have made a systematic examination of the blood in this affection. They conclude that in syphilitic iritis arising in the course of acute infection, there is a nearly normal number of leucocytes of mononuclear form. In non-syphilitic iritis arising in the course of acute infection, there is a decided leucocytosis; the leucocytes preserve their normal equilibrium, or, if this is destroyed, it is in the direction of polynucleosis. These results, derived from general pathology, do not always suffice to determine the origin of an iritis, but may, in some cases, assist in deciding a doubtful diagnosis.

Anderson (Graefe's *Arch. f. Ophth.,* lxxxiv, I, p. 172) records the case of a married woman, aged 58, who never had borne children, under treatment for recent syphilis. She had excoriated papules at the genitals and anus, papules all over the trunk, legs and arms, and some on the tongue and hard palate. Wassermann positive. R. eye: iritis with synechiæ. V.=fingers at ½ meter. Left eye: marked iritis, the lower portion of the anterior chamber filled with fibrin, cornea slightly opaque, edema of the lids, pupil irregularly dilated (by atropin), numerous synechaiæ, but not total seclusion. In the lower temporal quadrant a papule, scarcely the size of a hemp-seed,

projected into the anterior chamber; tension considerably increased. V. only motions of the hand. Severe pain in left temple, especially at night. On the fourth day a hemorrhage occurred on the surface of the papule, forming a small hyphema. After about eight days the papule had decreased in circumference and prominence, was entirely free and of a yellowish-white color.

On the tenth day the patient died from mercurial colitis. The histological examination of the left eye showed that the round papule had a diameter of 1.5 mm., was situated in the deepest layers of the iris as far as the pupillary margin and was separated by slightly changed iris tissue from the anterior surface of the iris. The iris at this place was thickened and adherent to the lens, the pigment layer lacking, but its remnants contained new-formed vessels. The papule itself showed an indistinct structure and was of a glossy, gelatinous aspect. The nuclei were less numerous and swollen, with diffuse accumulation of pigment in the surroundings. In the peripheral sections of the papules the sphincter was preserved, distinctly bulging towards the anterior surface of the iris, surrounded by infiltration with lymphocytes and hemorrhages; no giant or epitheloid cells. The blood vessels were thickened by infiltration with round cells in the adventitia and under the endothelium in the media. The same infiltrations with lymphocytes were found in the ciliary body, in the canal of Schlemm and the spaces of Fontana. Anderson does not assert that papulous luetic iritis must show the histological structure here described, as the virulence of the syphilitic virus and the power of individual resistance are variable, and believes that his case is a form intermediate between the case of simple luetic iritis examined by Fuchs and that of primary gumma of the iris described by Benoit.

Weidler (*Jour. Am. Med. Assn.*, Dec. 25, 1915) reports three cases of *condyloma in luetic iritis*, occurring, the first one, seven months, the second, seven months, and the third, three months after primary infection. In all three cases the growth was single, situated on the anterior surface of the iris near the pupillary border. The Wassermann test was positive (++++) in all of them, and in two of the cases marked improvement immediately followed the treatment by neo-salvarsan. In the third case, the patient refused to have this used, and was treated by iodid-mercury. In two weeks the eye was quiet, and the papule was reduced to one-fourth of the original size.

Santos Fernandez (*An. de Oft.*, Vol. 17, p. 145, 1913) describes nineteen cases of condyloma of the iris. The upper part of the anterior surface of the iris was occupied three times, the major vascular circle of the iris four, and the pupillary and ciliary borders of the iris

at the same time once, and the growth was situated between the pupillary and ciliary borders of the iris five times. All these cases were in men. In this connection he remarks that, of 978 cases of syphilitic iritis seen in the Havana eye clinic in the course of 39 years, 865 were in men, and only 113 in women. He attributes this difference as regards the sexes to the fact that in Cuba immigration is confined to men, and that women expose themselves less than men to syphilis. The patients' ages varied from 20 to 41 years.

In four cases the patient did not know he had contracted syphilis, not having observed the chancre. In one patient the condyloma appeared one month after chancre, in one two months after, and in others respectively, 2, 4, and 12 months after. In one 18 months had elapsed, in others 2, 3, and 4 years respectively.

Etiology of Iritis.

Many etiologic factors in iritis are undoubted—syphilis, gonorrhea, tubercle, etc.; others are less certain—rheumatism, pyorrhea alveolaris, dyspepsia and the uric acid diathesis. All the commoner varieties of pyogenic organisms or their toxins have been found in association with inflammation of the uveal tract.

Syphilis is accountable for about 50 per cent. of all cases of iritis. The iris is attacked both in congenital and acquired syphilis. In congenital syphilis it is rare as a simple manifestation, although of course in association with interstitial keratitis it is very common, since iritis occurs in all but the very slightest cases. In the acquired form it is seen as a secondary manifestation, often at the same time as the rash, and before the chancre has disappeared. Small yellow gummata form, generally near the margin of the iris. It also occurs as a tertiary symptom, many years later, and is then of a gummatous nature. A large number of the cases of "quiet iritis" are to be placed in the last group. As a rule an iritis due to syphilis is plastic in character and both eyes are affected.

Gonorrheal iritis. Of the causal relation of gonorrhea to iritis in certain subjects there can be but small room for doubt. Vetch appears to have been the first to have seen what might be called the gonorrheal syndrome. This is his remarkable observation of the liability to the succession in the same subject of gonorrheal urethritis, purulent ophthalmia arthritis and iritis. This observation was stigmatized as only a notion by Mackenzie twenty years later, but the conclusion of Vetch is regarded sufficiently justified today, at least as far as the urethritis, purulent ophthalmia and arthritis are concerned, although a gonorrheal iritis does not always follow.

This form of iritis was seen in a case of Mosso's (*Am. di Ott.*, xi, p. 458, 1912). A first urethral infection dated back four years, and had been accompanied by articular disturbances. A second urethritis occurred four or five weeks before the ocular involvement, and was complicated by joint symptoms. Two weeks after the onset of eye symptoms the pupil was contracted and the iris adherent and discolored, and in the anterior chamber was a large, reddish-yellow mass apparently connected with the posterior chamber by a sort of peduncle. There were hemorrhagic spots along the lesser circle. The exudate practically disappeared after three days treatment.

A well-marked and typical case of bilateral, gonorrheal iritis was reported by Shumway (*Trans. Sec. on Ophth., Coll. Phys., Phil.*, Nov., 1911). The patient had had four recurrences in five years with associated arthritis. Recovery followed after four injections of Neisser's bacterin. Cobbledick (*Ophthalmoscope*, x. p. 319, 1912) observed iritis (the fourth attack) complicated with optic neuritis, thirty years after gonorrhea. Gonococcal vaccination was followed by immediate improvement in the iritis. In a later communication he adds nine further cases in which iridocyclitis occurred in patients with antecedent gonorrhea dating back as far as thirty years, in nearly all of which, including the longest, gonococci were found in the urine. He concludes that acute unilateral cases which in the past have been classed as rheumatic are mostly, if not all, gonorrheal in origin. The prognosis is favorable. Gonococcus vaccine of mixed strains materially shortened the attacks, while giving rapid and complete relief to the "rheumatism" associated with these cases. Starodubzewa (*Klin. Monats. f. Augenh.*, Jan., 1911) thinks that a fresh or recurring iritis may be expected during an attack of gonorrheal arthritis.

A colored man 20 years of age, suffering from gonorrheal arthritis, was treated by E. A. Shumway (*Annals of Ophth.*, April, 1910), who administered gonococcus vaccine with improvement in the local symptoms. It was used irregularly because of a limited supply. After a month's treatment the right eye was attacked with iritis. No vaccine could be obtained, so only local treatment was used for nine days. A supply of vaccine was then obtained and a dose of 100 million organisms was administered. The following day the pain and photophobia had greatly diminished and the swollen joints were less tender. Three days later a similar injection was given, and the following day his subjective symptoms had entirely disappeared, the iris had resumed its normal appearance, and the circum-corneal injection was gone. In all, three injections were given and at the end of three weeks he was discharged cured.

Mackenzie was well acquainted with the disease, and noted the frequent association of iritis with synovitis, after exposure to cold, or over-exertion of the eyes, even without a fresh attack of urethritis. Generally one eye only is affected and may suffer repeatedly. The other eye may become inflamed later, and the attacks alternate between the two. Rarely are both eyes inflamed at once. The long interval usually elapsing between the initial urethral infection and the onset of iritis, as well as the fact that these secondary symptoms, or more properly metastases of gonorrhea, are exceptional and hence unexpected, cause the true cause to be overlooked. The iritis may come on years after the urethral attack. Higgens and Griffiths believe the iris becomes on occasions an excretory organ, and tries to eliminate the poison, receiving considerable damage in the effort. The chronic, attenuated virus does not seem to be strong enough to set up inflammation in the "acclimated" or immunized urogenital tract. There must also be a personal element of idiosyncrasy in those who suffer, as the proportion of persons who have iritis to those who have had gonorrhea is very small indeed.

Rheumatic iritis. The association of iritis with arthritis and myositis is so striking that a rheumatic group comprising, according to most text-books, about 25 per cent. of the cases, has been established. After excluding all other causal factors, such as syphilis, gonorrhea and tuberculosis, there remains a small group heretofore classed as idiopathic. In most cases, the action of toxins rather than the localization of bacteria is advanced to explain the development of iritis, repeated attacks being ascribed to sensitization of the tissues. Trauma of the eye, insignificant, or severe as in operations, has been recognized clinically as favoring the development of iritis without direct infection from the outside.

Examination of the blood and of infectious foci is giving us new views of the nature of iritis. The frequent finding of bacteria in blood cultures of apparently normal as well as of acutely febrile patients, with the presence of bacterial foci that are potential if not actual portals of entry, indicates that direct localization of organisms may be responsible for the lesions. In other words, the process may be analogous to that of arthritis, in which foci of infection are regarded as playing an important rôle. If this explanation is correct, sensitization may result from the lodging of bacterial emboli in the eye, and the rôle of trauma in the causation of disease of the eye may be as significant as it is in bone infections.

Clinical evidence in support of this view is not wanting. Stock (*Ergebn. d. allg. Path. u. Anat. d. Auges.* Lubarsch-Ostertag, 1910, p.

112) has reviewed the reports which indicate that pyogenic organisms may cause slight inflammation in the eye which soon subsides. More virulent infections, particularly with streptococci and pneumococci, as in septic abortion, have produced panophthalmitis. Experimentally, Stock produced iritis scarcely distinguishable from that of tuberculosis by intravenous injection of pathogenic yeasts. Korolkow operated on the iris of thirty-two rabbits previously injected with bacillus pyocyaneus, and produced suppurative iritis in five cases. Rosenow (*Jour. Infect. Dis.*, 1915, xvii, p. 403) injected animals with streptococci from various sources, and observed eye lesions, such as unilateral panophthalmitis, hemorrhage in the limbus with or without episcleritis, iritis or iridocyclitis, conjunctivitis, usually bilateral, and corneal ulcer. Of these lesions, 17 per cent. developed after injection of strains isolated from arthritis and myositis, and 15 per cent. after injection of strains from herpes zoster. Other strains failed to produce lesions unless brought to a certain grade of virulence by animal passage. He considers this localization as not accidental, and suggests that about the ciliary body or iris (about the joints and more tendinous part of the muscles) there is a gradation from an abundant to a poor blood supply, and consequently of oxygen, predisposing to the localization and growth of bacteria.

More recent experiments support the observation that many cases of iritis are infectious. Irons, Brown and Nadler (*Jour. Infect. Dis.*, 1916, xviii, 315) have produced iritis in rabbits by intravenous injections of streptococci isolated from a focus of infection in a patient suffering with iridocyclitis. Streptococci isolated from a chronic suppurating tear-duct produced iritis demonstrable clinically, by microscopic examination and by cultures in three of the first four rabbits injected, and in two of four animals injected with organisms isolated from the original source at a later date. Subsequent injections of biologically similar organisms isolated from the original source at intervals of about a week failed to produce eye lesions in a series of twenty-two rabbits. In one case iritis resulted from the injection of streptococci isolated from one of the infected eyes. In none of the animals were other gross lesions observed beyond an occasional arthritis.

With more careful search for foci of infection in cases of iritis, it is probable that the so-called rheumatic group will be found larger than supposed, and that many of the cases described as idiopathic are due to bacterial embolism from an undiscovered focus. The rôle of toxins apart from their elaboration in bacterial foci must be regarded as questionable.

"Rheumatic" iritis has, on the other hand, been scouted by some. It is strange, says Bishop Harman (*Lancet,* Nov. 4, 1911), how rarely we see iritis in subjects of acute rheumatic fever; and never an iritis during its progress or convalescence, notwithstanding the frequency or inflammations of other serous membranes. The massive purulent exudate into the anterior chamber of rabbits, following the injection of *micrococcus rheumaticus,* suggested rather a pyemia than an ordinary acute iritis. It is probable that many cases of iritis that are associated with a subacute articular malady, and supposed to be rheumatic in origin, are in reality cases of acute or subacute rheumatoid arthritis; that being, according to modern views, associated with chronic septic infection, often oral in origin; and in many cases, these varieties of iritis and iridocyclitis which have been classed as "rheumatic" are now described as "toxemic," in order to avoid reference to an unproved etiology.

In this variety of iritis, pain is usually severe, although in some cases it may be of the "quiet" variety. Repeated attacks are apt to occur and, as opposed to syphilitic iritis, may be confined to one eye at a time.

Serous iritis is characterized by the formation of yellowish dots on the posterior part of the cornea (punctate keratitis), with cloudiness of the aqueous. In this variety the ciliary body is usually inflamed at the same time (iridocyclitis). The synechiæ that form are not so tenacious and are more easily broken down than in the other forms of iritis. This form of iritis may be caused by syphilis. It is, also, the form of iritis often found in sympathetic ophthalmitis. Often the pupil is dilated and the tension of the eye increased by physical and chemic changes in the aqueous, thus simulating glaucoma. There is generally a deep anterior chamber.

Diabetic iritis is a rare form of ocular disease though it probably is more frequent than the published cases would suggest. Galezowski met with it 7 times among 144 diabetic patients with ocular diseases. Leber saw it 9 times among 39 diabetics. This type of iritis is of the plastic form, is often purulent, and when once established is likely to persist until the eye is seriously damaged. If recognized early, however, the iridal inflammation can generally be controlled; hypopion, when present, is usually small. The pupillary space is likely to be filled with a fibrinous membrane, which disappears rapidly under appropriate treatment. Occasionally the disease assumes the serous type. Complications may occur, such as cyclitis, choroiditis, cataract, and opacities in the vitreous body. Iritis following the operation of iridectomy is not infrequent in diabetics. Microscopic examination has shown the frequent occurrence of changes in the pigment-

epithelium layer of the iris, ciliary body and retina. They include a loosening, proliferation, and edematous swelling of the pigment-cell layer on the posterior surface of the iris. Hence, following an operation such as iridectomy or cataract extraction, the aqueous humor may appear black from pigment held in suspension. Zentmayer (*Ophth. Record*, May, 1913) observed a case of cataract extraction in a diabetic patient in which the operator, because of a too small corneal incision, had difficulty in delivering the lens. He introduced a hook, and on extracting the lens saw what appeared to be the entire iris hanging from the hook. On examination it was found to be a complete pigment cast of the posterior surface of the iris. Rollet and Genet (*Lyon Méd.*, Sept. 21, 1913) report a case in which hemorrhagic iritis was the first symptom to call attention to diabetes in a man of 51 years.

Toxemic iritis is an undoubted entity and to it probably belongs a fair percentage of the so-called ''idiopathic'' inflammations of the iris. Yeld (*Brit. Med. Jour.*, May 13, 1911), inquiring into the etiology of 159 cases of primary iritis occurring in the ophthalmic wards of St. Bartholomew's Hospital from 1883 to 1900, found 10 per cent. of them were due to toxemic conditions. Evidence of the intimate relationship existing between certain systemic conditions and ocular diseases is constantly accumulating, and the iris bears its share in this secondary disturbance. A few of the more recently recorded cases of iritis occurring as a direct result of systemic disturbance will be quoted here to prove the correctness of this etiological classification. Patterson (*Colo. Ophth. Soc.*, Feb. 15, 1913) reported a case of bilateral metastatic iritis in a boy who suffered from lobar pneumonia and lateral sinusitis, following a rapid otitis media with mastoiditis and epidural abscess. Guibert (*Clin. Opht.*, V. 19, p. 554, 1913) saw an iritis in three cases of gastro-intestinal intoxication, all of which responded with remarkable promptness to the use of a preparation of lactic acid ferments. Brawley (*Ophth. Record,* Nov., 1915, p. 568) also reports a case of iritis due to toxic products of disturbed metabolism, which improved rapidly under appropriate systemic treatment. Reber (*Ophth. Record*, Nov., 1915) reports an instance of plastic iritis of the classic type without venereal basis that was in all probability due to a post-influenzal toxin. Goulden (*Ophthalmoscope*, Vol. 9, p. 177, 1911) holds that oral sepsis is responsible for an important group of cases of iridocyclitis of generally unrecognized causation and for the more general symptoms of septicemia with which the ocular lesions are often associated. In one of the twenty-one cases of iridocyclitis recorded, a focus of septic absorption was

found in the tonsils. In thirteen cases sepsis in connection with the teeth was present. He also lays stress (*Roy. Lond. Oph. Hosp. Reports*, xix, 3, 1915) upon possible infections producing iritis by metastasis in cases of pyorrhea alveolaris, prostatic gonorrhea and uterine disease (dysmenorrhea, endometritis).

Traumatic, sympathetic, secondary, scrofulous, malarial and *tubercular* iritis, as well as the iritis due to *menstrual disorders*, are sufficiently indicated by their titles and suggest the additional treatment required by each. The few cases where iritis has occurred during, or closely after acute fevers, such as typhoid, malaria, influenza, and even mumps, or subsequent to exposure to cold or undue strain, are of a milder type than the above-mentioned forms, but they are just as liable to produce synechiæ and to endanger the vision.

Butler (*Brit. Med. Jour.*, Apr. 8, 1911) calls attention to the discrepancies in the reports of various authorities on the character of the etiologic factors in the production of iritis. The result of his inquiry was that in at least 30 per cent. of all cases it was impossible to determine the real cause of the disease; 25 per cent. more were due to syphilis, and only 5 or 6 per cent. could be termed rheumatic.

A report on 500 cases of iritis from the records of Wills Eye Hospital is given by C. W. Jennings and Emory Hill (*Ophthalmology*, Apr., 1909). The table bearing upon the origin of this important disease reads as follows:

Cause.	No. Cases.	Percentage.
Syphilis	307	61.4
Rheumatism	127	25.4
Gonorrhea	26	5.2
Influenza	7	1.4
Exposure	7	1.4
Tuberculosis	6	1.2
Malaria	6	1.2
Child-birth	3	.6
Typhoid fever	2	.4
Intra-uterine inflammation	2	.4
Diabetes	1	.2
Gout	1	.2
Pneumonia	1	.2
Cerebrospinal meningitis	1	.2
Measles	1	.2
Lead poisoning	1	.2
Rhus toxicodendron poisoning	1	.2
	500	100.00

From this table it appears that syphilis, rheumatism, and gonorrhea together caused 92 per cent. of the cases. Of the 307 syphilitic cases, 234 were males, 73 females. Both eyes were involved in 81 cases; but one eye in 226 cases; 14 cases occurred under twenty years of age, 119 occurred between twenty-one years and thirty years, 85 between thirty-one and forty years, 45 between forty-one and fifty years, and 21 cases over fifty years. Thus it would seem that the majority of the cases of syphilitic iritis occurred between the ages of twenty and fifty, the period of life in which syphilitic infection is most frequent.

Irons and Brown (*Jour. A. M. A.*, June 10, 1916) have recently been investigating the etiology of non-traumatic iritis. One hundred patients (forty-seven private and fifty-three clinical) have been studied, and after examining each patient as completely as possible, they have grouped them in accordance with the causes discovered in each.

This report does not assume to be a complete survey of the causes of iritis, but is rather a recital of the infections found and of the evidence for and against the etiologic relation of each to the iritis. The final conclusion as to the relative importance of each cause must be left to future studies.

Careful attention was given to the history, and a complete physical examination was made to detect the presence of syphilis, tuberculosis, gonococcal infection, and infections of teeth, tonsils, sinuses, prostate, pelvis or other structures which might give rise to lesions in joints or eyes. Laboratory examinations included Wassermann tests (ninety-eight patients) controlled by two laboratories, complement-fixation tests for gonococcal infection, roentgenograms of teeth and sinuses, and of the lungs when there was any question of pulmonary disease, and cultures of pus from tonsils, sinuses, prostate and other infected tissues. Tuberculin tests, 1, 3, 5 and 10 mg. being used, were made in suitable cases.

After a complete survey of the patient, appropriate measures were taken to remove all infections so far as possible. From the course of the iritis following these procedures, valuable evidence confirmatory of the etiologic diagnosis was obtained. In patients in whom but one source of infection was found, removal of which was followed by immediate improvement of a previously intractable iritis, no special difficulty was experienced in drawing reasonably safe conclusions as to the relation of cause and effect.

Two or more infections were found to be associated in a surprisingly large number of patients. In many of these the reason of the association was obvious; thus, infections of tonsils, sinuses and teeth, or

syphilis and gonococcal infection were often found together. In other instances, there was no apparent direct relation between two infections such as syphilitic iritis from secondary syphilis, associated with a latent alveolar abscess.

By a careful weighing of all the evidence, it was possible to determine in most cases which infection was probably responsible for the disease of the eye; but sometimes the available evidence was insufficient, and such cases are placed in a "combined" group. Some of these patients suffered from several infections. Syphilis, active tuberculosis, gonococcal infection and alveolar abscess were repeatedly found in the same individual.

The accompanying table summarizes (1) the number of times each infection was found in direct etiologic relation with the iritis, and (2) the coincident infections found.

THE CAUSES OF IRITIS IN ONE HUNDRED CASES (IRONS AND BROWN).

Infections	Alone	With other infections	Total	Coincident infections						
				Syphilis	Gonorrhea	Tuberculosis	Dental	Tonsil	Sinus	Genito-urinary
Syphilis	10	13	23	..	8	5	5	1	1	..
Gonococcal infection	7	2	9	..	..	..	1	1	..	..
Tuberculosis	8	..	8	..	..	..	..	..	..	..
Dental infection	7	11	18	2	2	2	..	7	1	..
Tonsillar infection	7	9	16	1	3	2	7	..	..	..
Sinus infection	1	2	3	..	..	..	1	1	..	..
Genito-urinary (non-venereal)	3	..	3	..	..	..	..	..	..	..
Other infections	2	..	2	..	..	..	1	..	..	..
No cause found	1	..	1	..	..	..	..	..	..	..
Combined infections	..	..	17	8	9	7	8	13	5	1
			100							

Diagnosis of Iritis.

Iritis is frequently mistaken for acute catarrhal conjunctivitis. The diagnosis can be made by attention to the following points: Conjunctivitis presents a discharge; uncomplicated iritis does not,

but generally in iritis there is an accompanying conjunctivitis. In conjunctivitis the greatest redness is situated posteriorly; in iritis the greatest redness is around the sclero-corneal margin. The redness of iritis is more deeply-seated than is that of conjunctivitis. The injected conjunctival vessels are distinctly seen, and disappear under slight pressure, while the deeper vessels of the circumcorneal zone present a deep, diffuse red color which does not disappear on pressure. The iris in conjunctivitis responds to light, while in early iritis it responds sluggishly, if at all; more often it is contracted and immobile. Vision is not affected in conjunctivitis, barring the spreading of mucus over the cornea, the existence of a complicating keratitis, or the presence of a corneal scar; in iritis vision is usually much reduced from turbidity of the aqueous humor or from exudation on the lens. The tension is not changed in conjunctivitis; in iritis there is occasionally increase of tension. The color and luster of the iris are not changed in conjunctivitis; in iritis the iris looks muddy, loses its bright appearance and is often changed in color. In conjunctivitis the pupil dilates regularly after the use of a mydriatic; in iritis the pupil may dilate regularly or irregularly.

Acute inflammatory glaucoma is sometimes mistaken for iritis; and if such a condition should be treated as an iritis, the result would probably be disastrous. The following points should prevent such a mistake being made: In iritis the pupil is small, in glaucoma it is large. In iritis the patient is usually under forty-five years of age, while in glaucoma the patient is usually over middle life. In iritis the tension may increase at the height of the disease; in glaucoma tension is increased intermittently or permanently. The anterior chamber in iritis is normal, except in cases where there is a complete annular synechia; in glaucoma the anterior chamber is shallow. The cornea in iritis is sensitive to the touch; in glaucoma it is anesthetic See, also, **Cyclitis.**

Treatment of Iritis.

There are three important considerations in the treatment of iritis: to keep the pupil as widely dilated as possible, to search out diligently the "causa causans," and to relieve the pain. As Noyes, years ago, truly said, "It is the beginning, the middle and the end of treatment" to keep the pupil dilated in order to prevent the formation of synechiæ or to break down those that have already formed. This is accomplished by means of one of the mydriatics. The sulphate of atropin is probably the most useful, either in the form of ointment or solution. A few drops of a one per cent. solution of atropin should

be instilled into the conjunctival sac, and repeated sufficiently often to paralyze the accommodation and to keep the pupil dilated. This may be aided or still further increased by adding to the atropin solution one per cent. of hydrochlorate of cocain and five per cent. of dionin. Atropin not only dilates the pupil and prevents dangerous adhesions to the lens, but it also relieves the congestion of the vessels both of the ciliary body and iris. It also applies the principle of ''rest cure'' to the inflamed eye by paralyzing not only the ciliary muscle but the sphincter iridis. In severe cases the patient should be kept in bed, or at least quiet and in a warm, even atmosphere and on light, nourishing food that is easily digested. Hot applications (as hot as can be borne) should be applied every hour or two in the form of moist pads, or as hot chamomile tea. Dry heat in the form of a Japanese ''hot-box'' at times gives more relief to the pain and vascular congestion than moist heat. As has just been stated, a valuable adjunct to atropin is a five per cent. solution of dionin. Five or six drops, each drop instilled at intervals of a minute, induce a serous exudation and marked chemosis of the conjunctiva. This artificially produced swelling acts as a lymphogogue and counter-irritant and gives great relief. If, towards night, the pains become severe and the pupil is slow in dilating, a blister, preferably cantharidal collodion, applied above the brow and to the temple, about noon, so that full vesication is obtained about seven o'clock, frequently gives great relief. The effect of this application is to anticipate the usual evening exacerbation and to prevent the nocturnal pains. In some cases, especially where the vascular congestion is very great, the abstraction of blood by means of the artificial leech, or by the application to the temple of two or three of the living animals, is a most effective remedy and may be necessary before the patient experiences any relief from his sufferings. Antipyrin in ten-grain doses, or twenty grains of aspirin, and even morphine, are sometimes required to subdue the pains and permit the patient to sleep.

In milder cases, if the patient is allowed to go out, he should wear smoked or amber-tinted glasses to protect the eye from the light and to ward off wind and dust.

Whatever may be the cause of the iritis, it is well to begin the treatment of every case by opening the bowels with a dose of calomel, followed by a saline. General treatment should be carried out when necessary by means of anti-syphilitic, anti-gonococcic, anti-tubercular, anti-lithemic, anti-diabetic, anti-rheumatic or other appropriate remedies. In addition to these systemic remedies the state of the general health often requires a course of iron, tonic doses of strychnia,

quinin or a combination of these. It must be remembered that iritis is usually a local manifestation of a general dyscrasia, may last weeks or months and may require care during the whole of that period. If adhesions have formed benefit is often derived from the internal administration of potassium iodid in large and increasing doses as an adjunct to the use of atropin, dionin and cocain. Sub-conjunctival injections of normal salt solution or sodium iodate and oxycyanide of mercury have also been given with success in many of these cases. In chronic cases, where the inflammatory symptoms have passed away, Turkish baths and mercurial inunctions are useful in helping absorption of the débris left by an acute attack.

Vaccine treatment has been successfully used in tubercle and gonorrhea, and in cases where the iritis is due to a chronic poisoning by a well-ascertained microorganism. Bradburne (*Ophthalmology,* Jan., 1912) reports excellent results from injecting 10 cc. of antistreptococcus polyvalent serum in a case of double iritis of streptococcal origin. Bronner (*Brit. Med. Jour.,* Mar. 22, 1912) treated a case of iritis of fourteen days' duration with the subconjunctival injection of 12 minims of a 1:5000 solution of cyanid of mercury, with rapid and marked improvement. Zorab (*Ophthalmoscope,* V. II, 1912) reports marked success in the treatment of iritis by internal administration every four hours of doses of from 2 to 4 minims of essential oil of cinnamon, cloves or peppermint. The oil is given after meals in gelatin capsules. In three cases of iritis of more or less certain tuberculosis etiology reported by Cohn (*Münch. Med. Woch.,* V. 60, 1912), sodium cinnamate (hetol) instilled into the conjunctival sac was followed by fairly rapid recovery. The drug, which has for some time been used rather extensively in the treatment of lung tuberculosis, was used in these cases every other day in 2 to 5 per cent. solution, with an admixture of novocain in the strength of 1 per cent., and preceded by a drop of 3 per cent. cocain solution. Török (*Arch. of Ophthal.,* p. 301, 1911) reported a case of tuberculous iritis of over two years standing, which was cured by tuberculin. A diagnostic injection of old tuberculin gave both general and local reaction. The patient had the symptoms of chronic iridocyclitis with posterior synechiæ, descemetitis, and opacities of the vitreous. In the course of treatment he received sixty-two injections of bacillary emulsion. The patient was apparently cured, with vision $^{20}/_{20}$, improved from $^{20}/_{200}$. Guaiacol, either in 3 per cent. ointment rubbed in the skin of the lids or subconjunctivally injected, is looked upon by some surgeons as a specific in tuberculous affections of the eye.

For a number of years Wray (*Medicine,* Oct., 1906) treated all his

cases of intraocular inflammation on the assumption that they were the result of bacterial action, and with gratifying results. Using gonorrheal iritis as an example, he reasons that the inflammation is due to the action of toxins and that the portion of the iris suspended in the aqueous and laved on both surfaces by toxin-laden fluid renders it particularly liable to attack; this reasoning may also be applied to syphilis and tuberculosis and possibly to diabetic iritis, although the presence of sugar may be a factor.

An objection, says Wray, to constitutional treatment is the slowness of its action. In the treatment of intraocular inflammations we must use remedies that we can rely upon to act in a few hours. If the toxins are in the aqueous they are obviously on their way into the general circulation. As this form of metabolism can be increased by compelling the patient to drink water copiously, all his patients are instructed to take exercise and copious potions of water. The same writer has also made it a rule for several years to inquire into the condition of the bowels in cases of iritis, corneal ulcer and other eye inflammations, he found, especially in children, they are mostly foul, often very foul, and the association is so frequent it can scarcely be a fortuitous one; hence he used to begin treatment of such cases by the internal administration of resorcin, salol, etc. He then found that acetozone was used with considerable success and safety in typhoid, and inferred, as it can be used in such asthenic conditions with advantage, it might be useful as an intestinal and general antiseptic in eye diseases. His method is as follows:

The patient drinks a tumbler of water and takes his capsule immediately, after which he walks briskly for 10 minutes, and then takes a second glass of water, and again walks for 10 to 15 minutes. The first dose is taken before breakfast, the next in the middle of the morning, middle of the afternoon, and in the evening. If the patient is seen early before the fourth day, iritis cases not infrequently experience relief from pain in a few hours, absence of redness on the sixth or seventh day. Of course, atropin and sometimes dionin were used at the same time.

After pointing out that for many years it had been the recognized opinion amongst ophthalmic surgeons that the performance of iridectomy should not be undertaken during the stage of acute inflammation of the iris, Bronner (*Ophth. Review*, Jan., 1909) described 6 cases in which he had performed this operation for the relief of pain, and in order to obtain dilatation of the pupil which had remained inactive in response to the usual treatment with atropine, leeches, and hot bathing. He, however, insisted on the use of the usual local and general

remedies, even though iridectomy had been performed. The results of the operation had been satisfactory in all his cases, and he suggested that iridectomy should be performed in all cases of iritis where the pupil refuses to dilate in 4 or 5 days under the ordinary methods of treatment. He excludes all cases of serous iritis and of sympathetic ophthalmia.

The therapy of a case of "quiet iritis," with its recurrences and insidious approach, requires inquiry as to its cause—whether it be luetic, gouty or autotoxic—chiefly because unless general treatment is resorted to relapses are likely to occur and the eyesight be threatened by posterior synechiæ and other sequels. In these cases the patient nearly always has some warning of an impending attack, in which case he should at once dilate his pupil with atropin and seek further aid from the ophthalmologist. Hutchinson regards "quiet iritis" as belonging to the plastic variety; other observers believe the changes to be mostly in the posterior pigment layer.—(C. P. S.) See, also, other **Iritis** rubrics.

Iritis catamenialis. An iritis just preceding or during menstruation, which may occur at regular intervals. It has been suggested by de Schweinitz that this form of iritis is due to abnormalities in the secretion from the uterus.

Iritis, Congenital. Bull observed congenital posterior synechiæ in infants within two hours after birth. The disease is to be attributed to syphilis, and this opinion is confirmed by the occurrence of "snuffles" within a few weeks after birth, and by the finding of mucous patches around the anus. Owing to the absence of ciliary injection and the infrequent occurrence of discoloration of the iris, iridal inflammation in infants may be overlooked. It can generally be detected only by the use of atropin and the oblique illumination.

Iritis, Croupous. Spongy iritis. This is a form of iritis rarely encountered. It is characterized by the presence in the anterior chamber of a mass of fibrin which at first fills this space, thus entirely obscuring the iris and the pupil. The mass of fibrin, which includes some leucocytes, forms a coagulum which subsequently shrinks, producing at certain stages the appearance of the crystalline lens dislocated into the anterior chamber. The shrinking continues and absorption progresses until eventually the mass entirely disappears. In the majority of cases no trace of the disorder remains. The onset of spongy iritis is relatively sudden, the flocculent mass being developed in from one to three days. The disease is due to traumatism, rheumatism, gout or syphilis. See, also, **Iritis.**

Iritis, Dental. See **Iritis**; also **Dental amblyopia**, p. 3817, Vol. V of this *Encyclopedia*.

Iritis, Diabetic. This form of iritis is usually of the mild plastic type, and occurs in about 5 per cent. of diabetics. See **Iritis.**

Iritis, Fibrinous. See **Iritis.**

Iritis, Glaucomatous. See **Iritis.**

Iritis, Gonorrheal. Blennorrhagic iritis. This form of iritis has at least two clinical varieties. The first or non-relapsing variety is rare and attacks a patient but once. It is not associated with any definite changes in the fasciæ or joints, but comes on in the early stages of gonorrhea. It generally affects both eyes, that exhibit a severe form of iritis. There is usually an exudate, and sometimes the pupils are occluded by a mass of lymph.

The second and much commoner variety of gonorrheal iritis affects the patient during the late or gleety stage. See **Blennorrhagic iritis**; as well as the major headings, **Iritis**, and **Gonorrhea, Ocular relations of.**

Iritis, Gouty. An inflammation of the iris occurring during an attack of gout, or in persons of gouty diathesis, and resembling very closely the rheumatic form of iritis, especially in the severity of the pain, the frequent relapses, and the spongy or gelatinous exudation. See **Gout**; **Iritis**; as well as **Iritis, Guttate.**

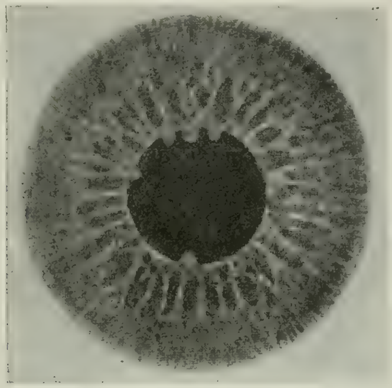
Iritis, Gummatous. See **Gumma of the eye**; also, **Iritis.**

Iritis, Guttate. This form of iritis is a very rare condition, but a very definite type. It occurs in elderly people, more frequently in women than in men, and in those who are obviously gouty; a true form of gouty iritis. The condition resembles drops of lymph on the margin of the pupil, hence the term "guttate" which was given to it by Doyne (*Trans. Ophth. Soc. Unit. King.*, Vol. 30, p. 91, 1910). The appearance, he states, is that of one or more small, warty-looking, almost translucent excrescences on the pupillary margin of the iris. They arise without any obvious signs of inflammation. They are situated just on the pigmentary edge, and the pupil contracts and dilates apparently unaffected by their presence and they may disappear without giving rise to inflammatory symptoms. It is apparently only when they adhere to the surface of the lens that inflammatory symptoms arise, but indeed, it may not be at the guttate spot that the iris adheres, but on some other portion which previously showed no abnormality. The adhesions, which extend over a much larger area than the circumference of the pupil, are soft and yield quite readily, but generally leave pigment on the lens.

The condition is supposed to be due to an exudation between the

epithelial layers of the iris which are reflected at the pupillary margin. This view is supported by the fact that the guttate spot does not become readily adherent to the lens, with which it must otherwise be in contact.

The attacks are readily relieved by atropin, but they are very obstinate in their recurrence. Usually not much pain is associated with the attack, though this is not always the case. Treatment should also be directed to the gouty diathesis.



Guttate Iritis.

Iritis, Hemorrhagic. See **Iritis.**

Iritis, Herpetic. Herpes of the iris has been observed in the course of herpes zoster frontalis. There is pain, followed by hyperemia and inflammation of the iris, plastic exudation, localized swelling of the iris tissue, necrosis of the swollen parts, hemorrhage of the ruptured vessels, and, finally, healing by cicatrization. The process may extend over a period of three months. See, **Herpes of the iris,** on p. 5881, Vol. VIII of this *Encyclopedia.*

Iritis, Idiopathic. See **Iritis.**

Iritis in general. See **Iritis.**

Iritis innominata. (L.) An old term for certain ill-defined forms of iritis.

Iritis leprosa. (L.) Leprosy of the iris. See **Leprosy.**

Iritis medorrhoica. (L.) (Obsolete.) A term for gonorrheal ophthalmia.

Iritis, Menstrual. See **Iritis catamenialis.**

Iritis, Metastatic. See **Iritis.**

Iritis nodosa. A nodular form of iritis has been observed as a result of the penetration of caterpillar hairs through the cornea or sclera

into the iris. In these cases similar nodules are observed in the conjunctiva. See **Iris, Tumors of the**; also **Conjunctivitis nodosa**; and p. 3123, Vol. IV, of this *Encyclopedia*.

Iritis, Papillary. One of the forms of syphilitic iritis, and identical with plastic iritis with the addition of minute nodules of dusky-red hue, which appear in the iris and are confined to the pupillary zone. The papules originate in the tissue-bearing capillaries, are devoid of large blood vessels, and resemble the papillary syphilides of the skin. They occur contemporaneously with the skin eruption in many cases. One or more nodules may be present. The entire pupillary zone may be crowded with them to such an extent that they appear to coalesce. See **Iritis.**

Iritis, Papulosa. See **Iris, Gumma of the.**

Iritis, Parenchymatous. Tubercular, gummatous and suppurative forms of iritis are all included under the general term of parenchymatous iritis. The iris is much thickened and distorted in all these varieties. See **Iritis.**

Iritis, Plastic. The type of iridal inflammation in which there is a tendency tc form adhesions between the iris and crystalline lens, and to occlude the pupil. See **Iritis.**

Iritis, Podophyllin. That caused by handlers of podophyllin from getting the dust of the drug into their eyes. (Gould).

Iritis, Prostatic. A name suggested for that form of the disease due to metastasis from a focus in the prostate, generally gonorrheal. See *Prac. Med. Series, Eye,* III, p. 82, 1916; also **Iritis.**

Iritis, Purulent. This is one of the most violent forms of iritis with which the ophthalmic surgeon has to deal. The affection is not confined to the iris, but soon involves the deeper ocular structures and results, almost without exception, in destruction of the eye. The most frequent cause of suppurative iritis is infection by a wound. In this form of iritis pus-cells are present in the tissue of the iris and hypopyon is common. The hypopyon of the idiopathic form of suppurative iritis disappears rapidly, since it consists only of pus-cells, and is not mixed with fibrin as in the hypopyon of ulcus serpens corneæ (Fick). Diabetes and acute infectious diseases, such as pneumonia, cerebro-spinal fever, influenza, etc., are causes of suppurative iritis. It also occurs from embolism in puerperal septicemia and pyemia. See, also, **Iritis.**

Iritis, Pyorrheal. Inflammation of the iris due to metastasis from infected teeth. See **Iritis.**

Iritis, Quiet. Attacks of iritis are occasionally encountered in which pain and inflammatory symptoms are very slight or even absent, but

the vision is perceptibly reduced. Careful examination will disclose the presence of synechiæ which have been gradually forming. To this condition the term "quiet" iritis was given by Jonathan Hutchinson.

Herbert (*Lancet,* May 16, 1913) thinks that the so-called "quiet iritis" after glaucoma operations is an expression of circulatory difficulty. Elliot (*Lancet,* Oct. 3, 1914) believes it to be due to alterations in the physical conditions of the aqueous chamber (shallow chamber and contracted pupil), and of its contained fluid, as the result of the operation. He would draw a distinction between it and the post-operative forms of iritis which may be met with as a result of sepsis in one form or another. Holth (*Ophthalmoscope,* Vol. 12, p. 347, 1913) has seen Elliot's quiet iritis appear in spite of every precaution, but thinks it can be more easily avoided with the punch than with the trephine. See, also, **Iritis** at the end of the section; as well as **Iritis, Senile**; and, the synonym, **Uveitis, Iridian.**

Iritis, Recurrent. Inflammations of the iris and ciliary body often show a great tendency to relapse. Recurrences do not necessarily depend upon the presence of posterior synechiæ, as was formerly supposed, but are frequently due to the constitutional basis which was the cause of the original attack, e. g., syphilis or rheumatism. Recurrences are seen in cases that have recovered without leaving any synechiæ; or we see a recurrence affecting, not the eye that was previously diseased, but the other eye which has hitherto been sound. The writer has under his observation at the present time a man who had an attack of iritis thirteen years ago, following acute articular rheumatism. He has had a recurrence once or twice every year since the first attack, the disease appearing as often in one eye as in the other, but never in both at the same time. There are no posterior synechiæ, but a few pigment deposits on the anterior capsule which were left from the synechiæ which formed during the first attack.

Nance (*Ophthalmic Record,* May, 1907) observed seven attacks of iritis in ten years, each of which recovered promptly under inunctions. The personal history was negative except for an attack of rheumatism three years after the first attack of iritis. In Melville Black's case (*Ophthalmic Record,* Feb., 1908) exclusion of the pupil followed delayed treatment of an iritis, that suffered a relapse two years later.—(C. P. S.)

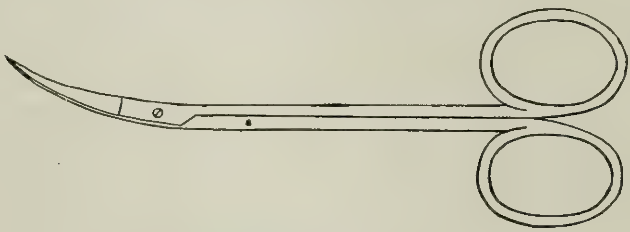
Iritis, Refraction changes in. The refractive condition of the eye after iritis demands attention. During the attack the emmetropic eye becomes myopic, the hypermetropic eye less so, and the myopic eye more myopic. This condition gradually disappears and the refraction returns to its original state. On account of the existence of this

transient myopia it is advisable to test the refraction several times during the year following recovery from iritis. See, also, **Index myopia.**

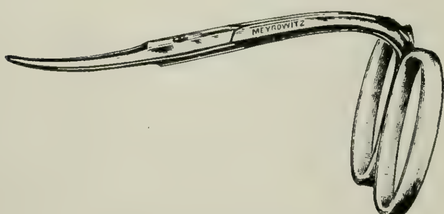
Iritis, Rheumatic. Rheumatism is supposed to be the cause of many cases of iritis; as much as 30 per cent. according to some observers. See **Iritis.**

Iris scissors. The method of use as well as a description of the instruments themselves will be found under **Iridectomy,** where de Wecker's *pince-ciseaux* and other forms of iris scissors are depicted. See, also, p. 1663, Vol. III of this *Encyclopedia.*

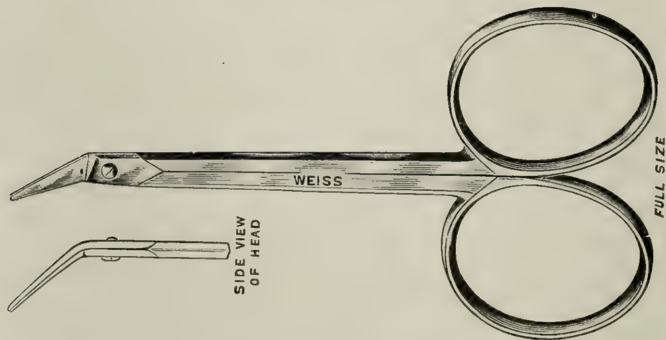
In addition to these comments a variety of scissors, intended to answer the same or similar purpose, are pictured here.



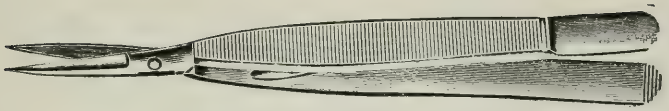
Ordinary Form of Iris Scissors.



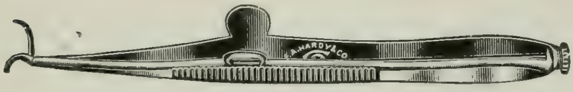
Frisch's Iris Scissors.



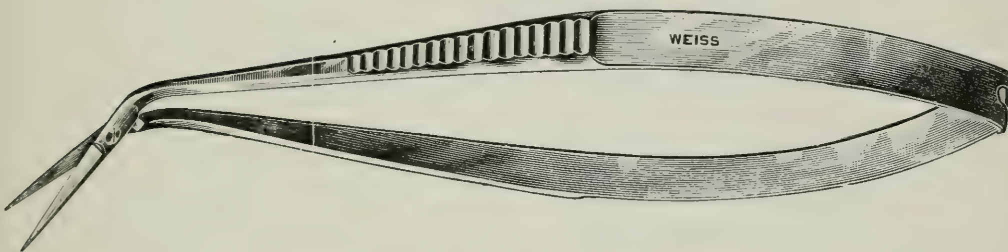
Lawson's Iris Scissors.



Mathieu's Straight Iris Scissors.



Woodruff's Iris Scissors with Blades Curved to the Side.



McDougall's Iris Scissors, with Spring Action.

Frederick Frisch (*Jour. Am. Med. Assocn.*, p. 1226, April 19, 1913) has invented an iris scissors whose advantages, he claims, are that with them it is always possible and convenient to support the hand, as we do with all other instruments, while using them for delicate operations, and that the handles can, as in these scissors, be shorter than in the ordinary instrument, and thus be less likely to obstruct the field of operation. See the figure.

Iritis, Secondary. See **Iritis.**

Iritis, Senile. In elderly persons it is not unusual to find that an iritis is overlooked because of the absence of the usual signs of this disease. There is no muddiness of the iris or aqueous humor, the pupil responds to light, tension is normal and pain is slight. The employment of a mydriatic and an examination under oblique illumination will show the true condition. Adhesions will be seen, either at the pupillary margin or more frequently at the peripheral parts of the iris. Two signs of diagnostic value have been pointed out by Hale: (a) one eye is usually involved more than the other and (b) the muco-purulent discharge characteristic of conjuctivitis disappears and is succeeded by profuse lacrimation. See, also, **Iritis, Quiet.**

Iritis, Serofibrinous. See **Iritis.**

Iritis, Serous. Iritis serosa. See **Keratitis, Punctate**; as well as **Descemetitis.**

Iritis, Spongy. Plastic iritis. This form of the disease may result in the pouring of an exudation into the anterior chamber, filling the pupillary area with a gelatin-like mass. See **Iritis.**

Iritis, Suppurative. See **Iritis, Purulent.**

Iritis, Sympathetic. A variety of the disease due to lesions of the fellow eye. The mild cases, known as uveitis serosa, show slight pericorneal injection, and slight discoloration of the iris. The iris is adherent to the lens capsule, the pupil is small, and the vision is reduced. The symptoms come on insidiously. Dots appear on the posterior surface of the cornea. The anterior chamber is increased in depth, the media are cloudy, and the optic nerve, while generally hazy and red, may show papillitis. The tension is at first slightly increased, then becomes variable, and in the later stages is permanently reduced. On account of the hyperemia, the color of the iris changes: a blue one appearing greenish, and a dark one brownish. The pupil, in sympathetic iritis, in spite of adhesions, will dilate under atropin (Pagenstecher). Recession of the iris-periphery is often seen. After a period of from a few weeks to several months, the eye as a rule, recovers completely under proper treatment. See **Sympathetic ophthalmia.**

Iritis, Syphilitic. See **Iritis**; also **Gumma of the eye**; and **Syphilis.**

Iritis, Toxemic. Iritis in toxemia generally indicates an intense systemic infection, and there are usually present the dull, sallow complexion, constipation, neurasthenia, and lassitude. Given a patient with these symptoms well marked, who is not syphilitic, and the diagnosis may not be difficult. But in other cases we have to contend with the uncertainties which always attend a diagnosis by exclusion (Beaumont). See **General diseases,** also **Iritis.**

Iritis, Traumatic. Traumatic iritis may arise from blows, operative procedures, penetrating wounds, or the lodgment of foreign bodies. See **Iritis**; and **Injuries of the eye.**

Iritis, Tubercular. See **Iritis,** as well as **Iris, Tuberculosis of the.**

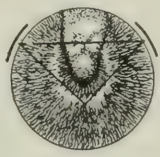
Iritis with cyclitis. See **Iridocyclitis.**

Iritoëctomy. The operation of making an artificial pupil by the removal of a thick membrane composed of the altered iris, capsule and iritic deposits. The various operations for this purpose are described under **After-cataract.** See, also, **Iridocapsulectomy.**

Here the steps of Elschnig's (*Klin. Monatsbl. f. Augenheilk.,* May, 1912) procedure are illustrated. See the cut.

With a narrow Graefe knife a puncture and counter puncture are

made as for cataract incision. When each cut is about 3 mm. long the knife is withdrawn, de Wecker's scissors is introduced, first at one opening, then at the other; the sharp blade being plunged through the iris and capsule and a cut made downward and to the median line; the second cut joining the first. Then a third cut is made horizontally and the tissue thus isolated withdrawn by iris forceps.



Incisions in the Limbus and Iris for Elschnig's Operation of Iritoëctomy.

Iritomy. See **Iridotomy.**

Iritomy, Peripheral. See under **Cataract, Senile.**

Iron. Ferrum. Iron in various forms was a common remedy in the hands of ancient Greco-Roman ophthalmologists. Metallic iron, iron rust, iron dross, ætitis, and siderites were all employed. The chief diseases in which these forms of iron were thought to be of value were: trachoma, exophthalmus, ophthalmitis, and any kind of ocular wound.—(T. H. S.)

Iron as a foreign body in the ocular tissues plays an important rôle in ophthalmology; and is extensively noticed (chiefly as steel) under **Injuries of the eye**; **Magnet**; **Electromagnet**; **Siderosis bulbi** and many other captions in this *Encyclopedia.*

Irotomy. A synonym of iridotomy.

Irradiation. Irradiance. Passing outward, in lines that spread in all directions, as in the case of rays of light; or fractures of a stellate form, etc. In *optics,* a series of phenomena in which a limited field, much more brightly illuminated than the background on which it is projected, appears larger than it really is; and, reciprocally, a dark limited field, projected on a bright background, appears smaller than it is in reality.

The explanation of these phenomena is that when a bright object is looked at, an image of it is formed on the retina, the receiving apparatus consisting of a number of separate stimulable elements or sets of elements; and for the maximum distinctness of vision no one of these elements should be affected by stimulation of its neighbors. If, however, the object be brilliant the image on the retina is correspondingly distinct, and neighboring sensitive elements participate in the excitement; a bright object thus looks larger than it is.

Irrational dispersion. See **Chromatic dispersion.**

Irre. (G.) A lunatic.

Irregular astigmatism. See p. 655, Vol. I of this *Encyclopedia.*

Irrenhaus. (G.) Lunatic asylum.

Irrigation, Intraocular. See **Intraocular irrigation.**

Irrigation of the eye. Lavage. Ocular irrigators. Undines. Irrigating fluids. Eye douches. Eye-cups. Sprays.

Numerous appliances for flushing the conjunctival sac, the bulbar surface, irrigating the anterior chamber and washing out post-operative and other cavities, are known to the ophthalmologist. Some of the external irrigators have already been discussed under **Eye-cup**; **Douche, Eye**; **Dropper**; still others, for intraocular and intraorbital use, have been pictured and described elsewhere, as will be later indicated in this section.

The common glass (and rubber bag) irrigator is a valuable means of conjunctival, corneal and orbital cleansing. The glass reservoir containing the irrigating fluid, usually warmed to 100° to 110° F., is held from 1 to 12 inches above the eye, according to the needs of the particular occasion, the force of the stream and the amount of escaping fluid being regulated by a stop-cock, the thumb and finger or by some other means. All the purposes of ordinary detergent flushing can be obtained by raising the bottom of the reservoir a few inches above the level of the eyeball. The hydraulic force thus utilized is, as a rule, sufficient for complete cleansing of the parts.

The ordinary Florence flask, fitted with a rubber cork through which pass two glass tubes, one for the entrance of air, the other for the exit of the irrigating fluid, is a satisfactory and convenient vessel for conjunctival flushing and is used in some hospitals.

A glass tube, six inches long, with rounded ends, one fitting into a soft bulb holding two to four ounces of fluid, also furnishes an excellent means of conjunctival cleansing. Be sure that no rubber débris enters the irrigating stream.

Irrigators for washing out the anterior chamber after a cataract extraction, in hypopyon, after penetrating wounds, etc., are of varied construction. Lippincott and others **(Cataract, Senile)** have devised ingenious apparatus of the kind that act with great satisfaction. Several special syringes are also used for the same purpose.

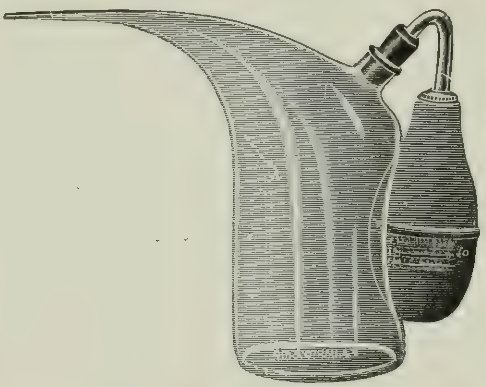
One of the best of these is a glass tube bent at an obtuse angle and terminated in a flat, rounded end about 3 mm. wide. This tube, inserted into a soft rubber bulb holding 2 ounces of water, will be found a simple, effective and easily-controlled anterior-chamber irrigator.

All these appliances should be capable of sterilization and should

be kept perfectly free of débris from the bulb and clean of dust, etc. Irrigators with soft-rubber tubing or bulbs should be inspected before using to see that they harbor no particles of detached rubber, zinc oxide, chalk or other ingredients that the economical rubber manufacturer is wont to add to the rubber itself.

The writer protests against irrigation with cotton dipped into the detergent fluid, inasmuch as minute fibrils of the former are very likely to find lodgment in the sac, on a roughened cornea or, worst of all, between the lips of wounds in the anterior segment of the eye.

Todd's eye irrigator is a valuable means of washing out and irrigating the conjunctival sac and other parts of the ocular apparatus. The illustration sufficiently indicates the method of using it.

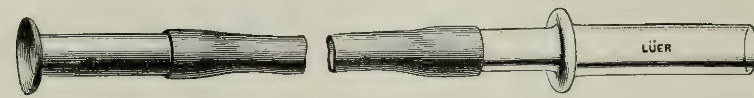


F. C. Todd's Eye Irrigator.

Sprays or nebulizers, so useful in throat and nose diseases, seem to have been forgotten or neglected in ophthalmic practice. Perhaps the difficulty experienced by the patient, who cannot see precisely what he is doing during the performance, may have something to do with this unpopularity. From time to time there appear on the market ingenious devices for the purpose, but they do not have a ready sale. This method should be given a trial (with an ordinary water nebulizer), in office practice especially. For home treatment there are on the market a number of pocket sprays, useful for applying evaporating lotions and collyria. The most popular irrigating fluids for detergent and germicidal purposes are weak solutions of sublimate, boric acid, borax, sodium chloride and similar salts.

At one time potassium permanganate was a favorite antiseptic in watery solutions of 1 to 2,000 to 500, both as a collyrium and for the treatment of lacrimal diseases, but in recent years it has fallen into

general disuse. Possibly its disagreeable and destructive staining qualities and the discovery of numerous other effective germicides have had something to do with this result. Kalt, who has had much experience with the use of large volumes of irrigating fluids in infections of the eye, also considers potassium, calcium and zinc permanganates to be very valuable disinfectants, and advises their use—1 gramme to 3 litres of water at 25° C. One eye is to be irrigated with the solution from two to four times daily, alternating, if need be, with irrigations of warm sterile water. See the cut of his own irrigator.



Kalt's Conjunctival Sac Irrigator.

To be used with the ordinary reservoir in external infections of the eye.

Tepid (100° F.) sterile douches of normal salt solution or distilled water act well in washing out the sac and are most soothing to the eye, particularly in the presence of mucus, pus or toxins.

Thompson (Wood's *System of Ophthalmic Therapeutics,* p. 53) claims that in prescribing collyria filtered water is better as a diluent than distilled water, since the latter acts injuriously on epithelial cells.

It seems strange that sodium bicarbonate is so little used in ophthalmic therapy, because it makes a good collyrium for detergent purposes, for irrigating the sac during the treatment of infective diseases of the eye and as a wash for the lid edges in cleansing the cilia, skin and adjoining mucous membrane from dried secretions. For all these purposes a 1 to 3 per cent. solution in distilled water is quite sufficient.

J. H. Claiborne (Wood's *System of Ophthalmic Therapeutics,* p. 66) says: "I have had rapid and satisfactory results, especially in the treatment of acute catarrhal infections of the eye, by the judicious use of eye sprays. I trim the eyelashes and allow a few drops of a 2-grain-to-the-ounce solution of silver nitrate to roll over the exposed mucous membrane, then I spray thoroughly with a solution of cocaine, about ¼ of a medicine dropper-full of a 2 to 4 per cent. solution and about 15-30 drops of borolyptol to an ordinary spray tube of water. In the summer I use ice water and in the winter warm applications. I then instill a drop of adrenalin chlor. 1-1000. At times I substitute (particularly in women) 1 gr. to the ounce of nitrate of silver, and in very sensitive cases I use only the borolyptol, cocaine and adrenalin, supplementing this with an appropriate treatment at home. To many people the spray is delightful; to others it is disagreeable. On trial

I find I use about 20-30 pounds pressure—less if disagreeable. I also find I use about 2 to 15 grains of cocaine and the same amount of borolyptol.

"I prescribe a spray at home which in nervous people is easier to use than drops. I tell the patient to pull over the lower lid well and look up while some one else sprays the following into the cul-de-sac freely 3 or 4 times a day: Cocain. hydrochlor., gr. i; Sodii bicarb.; Sodii chlorid. aa., gr. v; Sol. adrenalin chlorid. (1:1000), fl. ʒ i; Aquæ dest. ad., fl. ℥ i. I use the above as adjuvants in all cases of conjunctivitis, but I have found the results most brilliant in acute catarrh—particularly 'pinkeye.'"

D. T. Marshall (*The Medical News*, Dec. 26, 1903) is also much in favor of the use of sprays in many diseases of the conjunctiva, (including trachoma and phlyctenular diseases) and in ulcer of the cornea. He finds that many cases of blepharitis are benefited by this method when used as an adjunct to other forms of treatment.

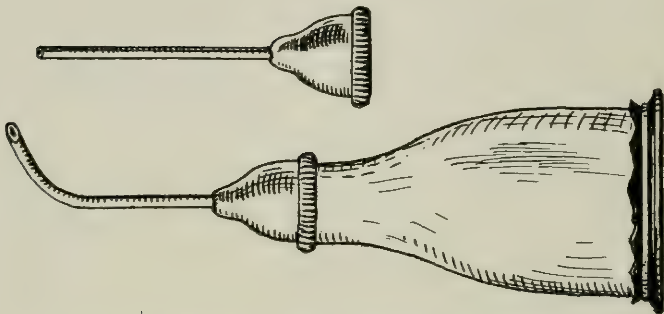
E. C. Ellett's combined chamber irrigator and lacrimal syringe resembles that formerly used by Keyser in Wills' Eye Hospital. The body of the instrument is of glass and shaped like a Gruber ear speculum with a lip surrounding the large end. The tip is of gold, fitting to the body with a friction joint. A piece of rubber dam covers the large end of the body, being held by a rubber band below the lip. The tip for use in the anterior chamber is suitably curved, flattened, and of generous caliber. The lacrimal tip is smaller, rounded in cross-section, and may be straight or curved.

The manner of using the instrument is apparent at a glance. (See the figure.) Its good features are its small size and lightness, and the fact that it can be readily sterilized by boiling. It works admirably, either in washing out cortical débris and blood after cataract extraction, or inflammatory exudates in hypopyon. It is intended that a fresh piece of rubber dam shall be put on each time the instrument is used.

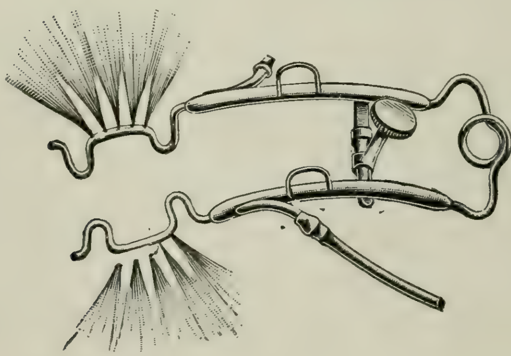
In the Fuchs irrigator (see the figure) the terminal is adjusted to an appropriate reservoir by means of rubber tubing and employed, both for irrigation of the conjunctival sac, and, like the Lippincott model, it may be used for washing out the anterior chamber.

Wieden, of Valencia, has devised an effective *conjunctival sac irrigator*—one of numerous instruments of the kind—in which a hollow lid elevator is made the means of spraying out mucus and pus from both the upper and lower sulci. They are made in different sizes to suit patients of varying ages. Lid speculum irrigators act in the same fashion.

De Vilbiss Eye Irrigator.



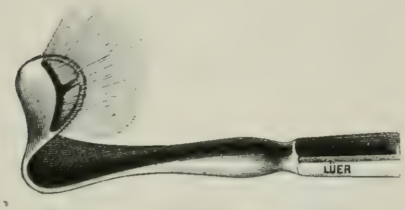
E. C. Ellett's Anterior Chamber Irrigator.



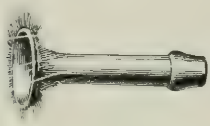
Pilling's Speculum Irrigator.

To be used in ophthalmia neonatorum and other forms of purulent conjunctivitis.

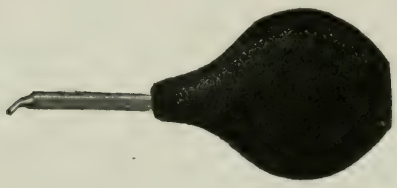
Fuchs' Irrigator.



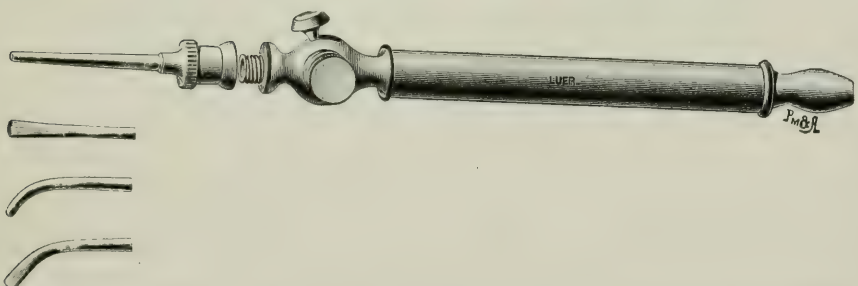
Wieden's Conjunctival Irrigator.



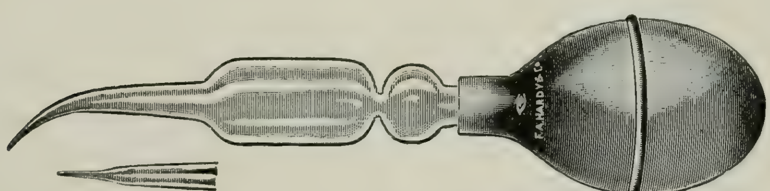
Moriez' Metal Conjunctival Irrigator.



Simple Anterior Chamber Irrigator.



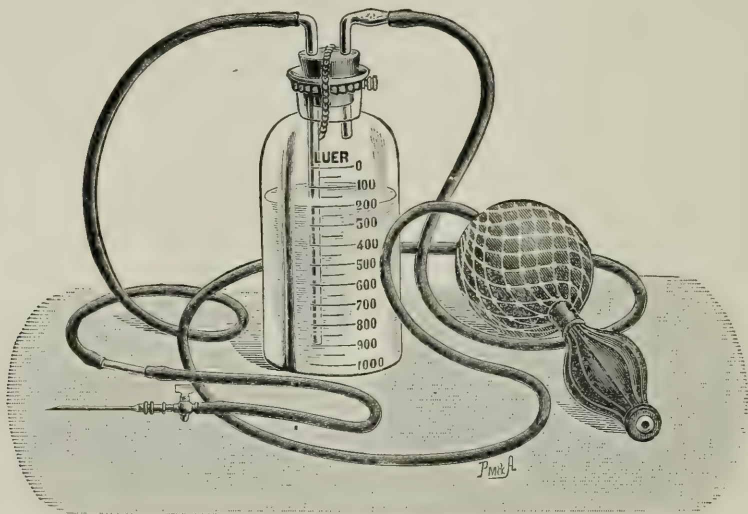
Combined (Metal) Conjunctival and Anterior Chamber Irrigator of Panas, with Stopcock and Terminals.
For use with the usual reservoir and rubber tube attachment.



Gibson's Anterior Chamber Syringe.

Bucky describes an apparatus adapted for continuous irrigation. It consists of an eye cup with connections for the attachment of rubber tubing by which any desired fluid may reach and leave the cup. It further contains a thermometer and metal electrode, so that the eye may be bathed in fluid of the desired temperature through which the electric current is passed.

Irrigation of the anterior chamber is fully described under **Cataract, Senile,** especially on p. 1699, Vol. III, of this *Encyclopedia,* to which the reader is referred. See, also, **Cataract, Unripe,** in which McKeown's method of irrigation is discussed.



The Pressure Irrigator of Panas.

For *deep irrigation of the orbit,* in cellulitis and after operations, either the devices commonly used for conjunctival lavage or special apparatus may be employed. One of the latter is recommended by Panas. From it the disinfecting fluid may be forced by means of a rubber bulb from a graduated bottle, as shown in the figure.

Irritation, Sympathetic. See **Sympathetic ophthalmia.**

Isaac. A Jewish patriarch, who presents the earliest instance of recorded blindness in all history. His life is outlined in the book of Genesis, xxi to xxviii, and xxxv, 27 to 29.

The story of Isaac's blindness, and the cruel deception which, in consequence of that infirmity, was possible to be practiced upon him, is of interest to all students of the history of ophthalmology.

Isaac Angelus, Emperor of the East. This man of many vices, who,

in his later years, was blinded by his brother Alexis, ruled as "The Emperor of Constantinople and the East" from A. D. 1185 to 1195. The circumstances under which he came to the throne were these: In 1185, Andronicus Comnenus, then the monarch of the East, fearing a conspiracy on the part of Isaac, sent one Hagio-Christophorites to assassinate him. Hagio-Christophorites, however, was killed by Isaac, who thereupon was declared by the people to be Emperor.

Isaac Angelus was engaged in numerous wars, and a very peculiar feature of his conduct concerning these matters was that all the expeditions which he sent against his enemies he placed in the hands of generals who had been blinded by Andronicus.

Isaac was a thoroughly weak and vicious man. Gibbon says: "Isaac slept on the throne, and was awakened only by the sound of pleasure." Hence the numerous conspiracies against him. Each of these attempts, strangely enough (as if it were a forecast of his own doom) he punished by putting out the eyes of the leaders. At last his brother Alexis (whom he had always trusted) rebelled against him, deposed him, and deprived him of his sight. Isaac was then imprisoned for eight years, when Dandolo, the blind Doge of Venice, with the assistance of the Crusaders, replaced him on the throne. Inside of a year, however, he was again deposed, and was then put to death by Alexis Ducas.—(T. H. S.)

Isaac Judaeus. A famous physician of the Arabian middle ages who practised first in Egypt, afterward in Kairwan. He was chiefly known as a general practitioner, but his writings on the eye (none of which are extant) are referred to once by Alcoati and a number of times by Rhazes in the second book of his "*Continens.*"—(T. H. S.)

Isagogique. (F.) Applied to what is done as a preliminary to a description, to a phenomenon or to an operation.

Isapogen. A proprietary liquid containing 6 per cent. iodin and 6 per cent. camphor: used in rheumatic, tuberculous, and syphilitic conditions by inunction.

Isarol. See **Sphagnol.**

Isatophan. A proprietary yellow crystalline powder, a methoxy derivative of atophan: used in ophthalmic practice like atophan and novatophan, in ½–1 grm. doses, for the internal treatment of choroidal and other uveal affections, much as the salicylates are commonly employed.

Ischemia of the retina. See **Retina, Ischemia of the.**

Ischuriophthalmia. (L.) (Obsolete.) Ophthalmia supposed to result from the suppression of urine.

Ishaq al-Israili. See **Isaac Judaeus.**

Isis. An ancient Egyptian goddess, whose healing powers were especially at the command of ophthalmic patients. Long and widely known in antiquity was the eye-salve called "the plaster of Isis." Isis would, in fact, appear to have been, among the gods, "a general practitioner, paying especial attention to diseases of the eye."—(T. H. S.)

Isobody. An antibody which is active for tissues of other animals of the same species as the animal from which it is derived.

Isobutylaldehyd. This aldehyd acts on animals much the same as does formaldehyd in producing contracted pupils as a part of the intoxication.

Isochasmic. Indicating equality as to the frequency of auroral displays.

Isochromatic. Having the same color; of uniform tint.

Isochromatophil. Staining equally with the same dye.

Isochroous. Of uniform color.

Isoclinal. Isoclinic. Of equal inclination.

Isococain. A patented, artificial (synthetic) alkaloid; a local anesthetic, said to be more speedy in its action than cocain, but not suited for use in eye treatment.

Isocomplement. A complement from the same individual, or one of the same species, which furnishes the amboceptor.

Isocoria. Equality in size of the two pupils.

Isodiametric. Having equal diameters.

Isodique. (F.) Going from without inwards. Centripetal.

Isoform. An antiseptic composed of equal parts of iodoxyanisol and calcium phosphate.

Isogonal. Isogonic. Having equal angles.

Isogonal circle. See **Circle, Isogonal.**

Isogonal surface. According to Savage (*Ophthalmic Myology,* p. 102), this term may be defined as follows:—the two visual lines, whether direct or indirect, from corresponding retinal points, converging at any point on this surface, from the same angle as the two visual lines converging at any other point on this surface.

Isogoniostat. A device for regulating the movement of the prism train of a spectroscope.

Isokrystar lenses. This is a trade (Emil Busch) name given to spectacle lenses of the improved periscopic or "punctiform depiction" variety; in other words, objects viewed through such a lens are seen quite free from astigmatic aberration or distortion at every point in their length and width and at any inclination of the eye.

In most globular, half globular and meniscus lenses, neither the ex-

terior radius nor the interior one is the same in any two cases; the other surface is therefore worked in the opposite manner to give the focus; in isokrystar lenses, every diopter has been calculated individually and is corrected for itself as regards astigmatism.

For this correction, the distance taken as a base was 13 mm. from the axis of rotation of the eye to the cornea, the distance being measured to the point having the largest curve, and a distance of 13 mm. from the most curved part at the back of the lens to the top of the cornea.

Isometropia. That condition in which the refraction of both eyes is the same in kind and degree.

Isomorphism. Similarity of crystalline form.

Isomuscarinchlorid. This poisonous substance, derived from the *Agaricus muscarius,* has been instilled by Lewin as a half per cent. solution (*Lehrbuch der Toxikologie* 2. 1897, p. 409) into the eyes of cats. It produced a temporary but rapid contraction of the pupil.

Isopathotherapy. Isopathy. The treatment of disease by administering (1) some portion of the body of another individual either affected with the same disease or associated with its causation; or (2) a portion of the products of the same disease in another individual (e. g., powdered worms as a vermifuge, the hair or a rabid dog in rabies, or the matter from a small-pox pustule in variola).

Isophoria. A condition in which the tension of the vertical muscles of each eye is equal, so that the visual lines lie in the same horizontal plane.

Isophysostigmin. As noted in Wood's *System of Ophthalmic Therapeutics,* p. 492, regarding this miotic, Nikanarow, in a communication to the St. Petersburg Ophthalmic Society on December 14, 1906, claimed that a 1/10 per cent. solution of the salicylate is well borne by patients. Three drops caused a distinct lowering of the intraocular tension and this decrease lasted longer than that caused by a one per cent. eserine solution. Isophysostigmin does not irritate the eye and cause pain, as is often the case with a one per cent. solution of eserine. A hyperopia of 4 diopters was converted into an apparent myopia by the use of the drug. After two months' constant use there were no traces of hyperemia of the conjunctiva. Although it is two or three times dearer than eserine, the smaller dosage makes its use comparatively inexpensive, while Nikanarow believes it is a more effective drug than eserine.

Isophysostigmin has also been investigated by Ogiu (*Die Therapie der Gegenwart,* Nov., 1904) who found that it acts much more quickly upon the pupil, and with greater energy and for a longer period than

physostigmine. Stephenson thinks, from his experience in the treatment with it of a case of conical cornea, that, although it is a powerful and efficient miotic it is prone to act as an ocular irritant.

Isophysostigmin sulphate is found with *escrin* (physostigmin) in Calabar bean, is quite soluble in water and acts as a *powerful miotic.* Merck says that 1/80 gr. is equal in this respect to 1/60 gr. of eserine sulphate. Solutions should be kept in amber bottles.

Isopia. Equality of vision in both eyes.

Isopilocarpidin. This compound is practically the same agent as jaborindin, which in its turn is a derivative of pilocarpidin and produces much the same symptoms as the last named agent.

Isopilocarpin. This derivative of pilocarpin acts in much the same way upon the ocular accommodation as does the latter drug.

Isopral. Trichlorisopropyl alcohol, a white, crystalline substance, soluble in ether, alcohol, and water. It is used as a hypnotic like chloral hydrate.

Isopropylhydrocuprein. Morgenroth (*Wien. Klin. Rundschau,* March, 1913) has proved that a very weak solution of this drug produces an intense anesthesia of the cornea, which is of quite long duration. Sterilizing the solution by heat does not change its strength. The toxicity is comparatively slight.

Isopter. This is a term adopted by Groenouw, who designates as isopters the lines drawn in the visual field through the points where the visual acuity is the same.

Isosceles. Having two equal sides.

Isoscope. An instrument devised by Helmholtz for determining the position of the vertical and horizontal lines of division in various movements of the eye. It consists of a firmly fixed frame provided with one or several wires, which are at first vertical, for the other eye. In using the instrument, the movable frame is to be so adjusted that the binocular projected wires seem parallel to one another.

Isoserum. A serum obtained from a person who has had the same disease as the patient who is being treated.

Isotonic. Having the same tone or tension; of a muscle, in a condition where there is no change of initial tensions, and stimulation leads merely to the shortening of the muscle, as opposed to the *isometric* condition, where there can be no change in the length of the muscle, and stimulation produces only a change in tension. (Foster).

Isotropic. Isotropous. Having the same properties in all directions; said of a medium with respect to elasticity, conduction of heat or electricity, or radiation of heat and light. Thus, all crystallized sub-

stances belonging to the *isometric* system are isotropic with respect to heat and light.

Isteria. (It.) Hysteria.

Italian method. See **Blepharoplasty.**

Italy, Laws of, Relating to ophthalmology. See **Legal relations of ophthalmology.**

Itch. SCABIES. PEDICULOSIS. This well-known skin disease is produced by a minute mite (*Sarcoptes scabiei*), which burrows in the epidermis of most parts of the body, but especially about the hands. Its presence is marked by a small scaly elevation of the skin, by eruptions as the papillæ of the cutis are perforated, and by the irritating itching sensation.

The mite itself is white or yellowish, broad and flat, with two pairs of mouth parts, and four pairs of appendages. The males are scarcer and much smaller than the females, which are just visible to the naked eye. When they have entered the skin they do not leave it, but form tortuous burrows, through openings in which the embryos escape. The mites are passed by contagion from person to person, either by direct contact or by clothes or bedding. It is probably the embryos or larvæ which are usually thus transmitted.—*Standard Encyclopedia.* See **Blepharitis pediculosa.**

Iter a tertio ad quartum ventriculum. (L.) The aqueduct of Sylvius.

Itrol. SILVER CITRATE. $C_6H_5O_7Ag_3$. This agent occurs in the form of a white, heavy, odorless powder which darkens on exposure to light. It is used where a dry, non-corrosive antiseptic is required. It is made by precipitating a solution of silver nitrate by means of citric acid and sodium bicarbonate.

This agent is barely soluble (1:4000) in water. It is consequently mostly used as a powder for dusting wounds, upon the conjunctiva, etc., forming a valuable non-irritating antiseptic. Paul Meyer found it especially useful in infected wounds of the lids, conjunctiva and orbit, and advises that it be blown on them with an insufflator. Good results almost always followed, even in infected wounds of the eyeball, when this product was applied to the wound. In fact, in all the commoner, infectious, external diseases itrol was found useful, with the exception of tuberculous infections. Some pain is felt but this is due to the mechanical effect of the insufflation. Insufflation is necessary, however, as one must have penetration, and cocain may be employed to allay the irritation. It is always necessary to use fresh itrol made by a reliable chemist.

Itterizia. (It.) Yellow jaundice.

Ivoire. (F.) Ivory.

Ivory-ball test. This test of the approximate visual acuity in young children is highly approved by Worth (*Squint,* p. 85). He uses five little ivory balls varying in size from half-an-inch to one-and-a-half inches in diameter. The child is first allowed to handle the balls with both eyes open. Then one eye is covered by a pad, or, if he wears glasses, by a piece of cotton wool stuffed behind the lens. He is then asked to go and pick up the balls as they are thrown on the floor at a distance of six or seven yards, one by one, beginning with the largest. By spinning the ball in the fingers as it is thrown, it can be made to "break" on touching the floor, so that it does not go quite in the direction in which it appears to have been thrown. It is easy to tell, by the way in which the child runs for the ball, whether he really sees it before he starts or is only going to look for it. The writer tests the presumably better eye first, so as to give the other eye the benefit of experience.

Ivresse. (F.) Drunkenness; intoxication.

Ivrognerie. (F.) State of intoxication or of drunkenness.

Ivy. Hedera helix. Called by Archigenes "kittós." Ivy was used by ancient Greco-Roman ophthalmologists as a poultice for the eyes. For this purpose it was mixed with bread and acacia.—(T. H. S.)

Iwanoff, Alexander. A celebrated Russian ophthalmologist, renowned for investigations into the pathologic anatomy of the eye. Born in 1836, he studied for a number of years at Moscow. Compelled to relinquish his studies in 1859, because of tuberculosis, he proceeded to Montpellier, in the South of France, in search of the health which was never to be his. While at Montpellier, however, he became acquainted with Pagenstecher, and was filled by this ophthalmologist with such an enthusiasm for ophthalmology, that he determined to devote his practice exclusively to the treatment of the eye. He thereupon studied ophthalmology with Knapp at Heidelberg, with Pagenstecher at Wiesbaden, and with Arlt in Vienna. In 1867 he entered the University of St. Petersburg, at which institution he soon received the degree of Doctor of Medicine. At the cost of the Russian Government (on account of his distinguished ability) he studied ophthalmology abroad for two years more. Then, in 1869, he settled at Kiev, Russia, where he had been already appointed full professor of ophthalmology. After a number of visits to kindlier climates than that of Russia, he succumbed to his pulmonary disease at Mentone, France, Oct. 15, 1880. Iwanoff's most important ophthalmologic writings are as follows: 1. Zur Anatomie des Glaskörpers. (Zehender's *Klin. Monatsb.,* 1864.) 2. Ueber die Verschiedenen Entzündungsformen der Retina. (*Ibid.,* 1864.) 3. Zur Ablösung der Chorioidea. (Graefe's *Archiv,* XI.)

4. Zur Normalen und Pathologischen Anatomie des Glaskörpers. (*Ibid.*, XII.) 5. Ueber Neuritis Optica. (*Ibid.*, 1868.) 6. Ueber Chorioiditis Disseminata. (*Ibid.*, 1869.) 7. Zur Pathologie der Retina. (*Ibid.*, XII.) 8. Beiträge zur Anatomie des Ciliarmuskels. (*Ibid.*, XV.) 9. Mikroskopische Anatomie des Uvealtractus und der Linse. (*Handb. der Ges. Augenheilk.*, Graefe und Sämisch, Vol. I, Chap 3, 1874.) 10. Zur Pathologischen Anatomie des Trachoms. (*Ber. der Ophthalm. Gesellsch.*, 1878.)—(T. H. S.)

Iwanoff's cysts. These growths are not infrequently found in the retina behind the ora serrata in senile subjects. According to Parsons (*Pathology of the Eye*, p. 621) they were first described by Blessig (1855), subsequently by Henle (1866), and more minutely by Iwanoff (1869). The latter found them in children and adults, but most frequently from 50 to 80 years of age. The oval or round cystic spaces, which he called "colloid cysts", occurred in the inner and outer nuclear layers: they were bounded by the supporting fibres of the retina—Müller's fibres, and the walls were often so attenuated that they communicated with one another. They were usually 2 to 8 mm. behind the ora serrata, and contained an albuminous serum or a gelatinous substance. Iwanoff regarded them as due to an edema of the retina, and he mentions the coexistence of vascular changes and fatty and calcareous degeneration, attributing special importance to calcareous degeneration of the capillaries.

Ixodes ricinus. This insect, the dog-tick of Europe, sometimes burrows beneath the skin of the human eye-lid, where it may form a small cyst. It is well, in such cases, to remove it by massage with vaselin or strong salt water. Roughness in dislodging may result in leaving behind the sting, when a disagreeable inflammation may be set up.

Ixodiasis is the name given to the bite of ticks of the genus *Ixodes.*

J

Jaborandi. See **Pilocarpin.**

Jaborandin. A name for pilocarpine.

Jaboridin. An amorphous base, an oxidation product of pilocarpidin; said to be identical with the pilocarpin of Parodi, and with the base obtained by Chastaing by the oxidation of pilocarpin.

Jaborin. A colorless, amorphous alkaloid, prepared by heating a concentrated acid solution of pilocarpin. It possesses properties much like those of atropine.

Jackson, John Hughlings. A celebrated English ophthalmologist and neurologist, who gave his name to Jacksonian epilepsy. Born at York, England, April 4, 1834, he attended the York Medical School and Saint Bartholomew's Hospital, London. In 1860 he received the degree of M. D. from the University of St. Andrews, and in 1868 became a Fellow of the Royal College of Physicians of London. In 1874 he was made physician at the London Hospital, in which he was long famous as a teacher. He died at his home in Manchester Square, London, Oct. 7, 1911, aged 77.

Hughlings Jackson was a voluminous writer and ophthalmologists owe to him many acute observations of ocular symptoms indicative of nervous diseases.

In addition to works and articles outside our special field, he wrote: 1. Observations on Defects of Sight in Brain Disease and Ophthalmoscopic Examination during Sleep. (*Royal Lond. Oph. Hosp. Rep.*, 1863-5, IV.) 2. A Physician's Notes on Ophthalmology. (*Ibid.*, 1873, VII; 1874, VIII.) 3. A Physician's Notes on Ophthalmology, Second Series. (*Ibid.*, 1875, VIII.) 4. Remarks on the Routine Use of the Ophthalmoscope in Cerebral Disease. (*Med. Press and Circ.*, Lond., 1879, n. s., XXVII.) 5. Discussion on the Relation Between Optic Neuritis and Intracranial Disease. (*Tr. Ophth. Soc. U. Kingdom*, Lond., 1880-81, I.) 6. On Eye Symptoms in Locomotor Ataxy. (*Tr. Ophth. Soc. U. Kingdom*, Lond., 1880-81, I.) 7. On Optic Neuritis in Intracranial Disease. (*Med. Times and Gaz.*, Lond., 1881, I.) 8. On Ocular Movements with Vertigo, Produced by Pressure on a Diseased Ear. (*Tr. Ophth. Soc. U. Kingdom*, Lond., 1882-3, III.) 9. Ophthalmology and Diseases of the Nervous System, Being the Bowman Lecture. (*Tr. Ophth. Soc. U. Kingdom*, Lond., 1885-6, VI.)—(T. H. S.)

Jackson's test. For the detection of feigned blindness, Edward Jackson advises that two cylinders with their axes at right angles be placed before the good eye while the suspected eye is covered with a correcting lens. The patient is then asked to read and while doing so one of the cylinders is rapidly rotated so that the healthy eye is prevented from seeing. If the suspected person continues to read, he must do so with the alleged amblyopic or entirely blind eye.

Jacobæa tomentosa. CINERARIA MARITIMA. See p. 2251, Vol. III, of this *Encyclopedia*.

Jacob, Archibald Hamilton. A well-known Irish ophthalmologist, founder of the Dublin Eye and Ear Infirmary. He was born at Dublin May 13, 1837, the fourth son of the distinguished Dublin ophthalmologist, Arthur Jacob. He received the medical degree in 1862, and, in 1866, he succeeded his father as ophthalmic surgeon to the City of Dublin Hospital. This position, however, he resigned in 1870, and in 1872 founded the Dublin Eye and Ear Infirmary, in which institution he was surgeon-in-chief until 1875. In 1882 he was made Professor of Ophthalmology at the College of Surgeons. In 1884 he became a Fellow of the Council of the Royal College of Surgeons. He died in 1901.

For a long time Dr. Jacob was editor-in-chief and sole owner of the "*Medical Press and Circular*," and in that journal his most important ophthalmologic articles were published, to wit: "On Ophthalmic Surgery," "Comparative Statistics of Various Methods of Cataract Extraction," "Anatomy and Physiological Functions of the Crystalline Lens."—(T. H. S.)

Jacob, Arthur. A celebrated Irish anatomist and ophthalmologist, father of Archibald Hamilton Jacob (*vide supra*), and himself the discoverer of Jacob's membrane (the layer of rods and cones in the retina) and (practically, at least) the discoverer of "Jacob's ulcer." Born June 13, 1790, at Knockfin, near Maryborough, Queen's County, Ireland, the grandson, son, and brother of well-known general surgeons, he began to study medicine in 1807 at Steevens Hospital, Dublin, receiving the medical degree at Edinburgh in 1814. After a year of further study in Paris and London, he returned to Ireland and settled in Dublin.

In conjunction with Graves, Marsh, Cusack and Hart, he founded the Park Street Medical School, which lived a few years. In 1826 he became Professor of Anatomy and Physiology at the Royal College of Surgeons of Ireland, and in this position became a celebrated teacher. In his practice he devoted his attention chiefly, but not exclusively, to ophthalmology, and, in his anatomical investigations,

was also chiefly concerned with the eye. He was a broad man, however, and deeply interested in almost every branch of natural science. In 1838 he founded, with Maunsell, "*The Dublin Medical Press,*" and in 1852 assisted in the institution of The City of Dublin Hospital. He also founded, or assisted in founding, the Royal Medical Benevolent Fund and The Irish Medical Association.

Jacob was thrice elected president of the Royal College of Surgeons. In 1860 a gold medal was struck in his honor, while, in 1874, his bust, his portrait in oils, and his great collection of medical works were installed in the hall of the Royal College of Surgeons.

Jacob was an extremely industrious man, up early and late, and always writing, teaching, operating or investigating, or perhaps performing some kindly office for a student. He was honest, upright, outspoken, perhaps a little stubborn or opinionated,* but ready to forgive and be forgiven. He had many enemies, but more friends.

Jacob taught and practised till eighty years of age. Then, in 1869, when a very large number of the leading ophthalmologists of foreign countries (notably Henry Howard, the first of Canadian ophthalmologists) had been his students, he retired to the house of his son at Barrow-in-Furness, Lancashire, where he died Sept. 24, 1874, aged 85.

Jacob's most important writing was that in which he announced his discovery of what today is known as Jacob's membrane. It appeared in the *Philosophical Transactions* for 1819, at page 300, and, in accordance with our plan to reproduce in this *Encyclopedia* the briefer and more important classics in ophthalmology of every place and time, we here subjoin the article in question: *An Account of a Membrane in the Eye, now first described. By* Arthur Jacob, *M. D. Member of the Royal College of Surgeons in Ireland, Demonstrator of Anatomy and Lecturer on Diseases of the Eye in the University of Dublin. Communicated by* James Macartney, *M. D. F. R. S.* Read July 1, 1819.

"Anatomists describe the retina as consisting of two portions, the medullary expansion of the nerve, and a membranous or vascular layer. The former externally, next to the choroid coat, and the latter internally, next to the vitreous humor. All, however, except Albinus and some of his disciples, agree, that the nervous layer cannot be separated so as to prevent the appearance of a distinct membrane, though it may be scraped off, leaving the vascular layer perfect. That the medullary expansion of the optic nerve is supported by a vascular

* He refused, for example, to be convinced of the value of von Graefe's iridectomy for glaucoma—which he called "the glaucoma dodge."

layer, does not I think admit of doubt; but it does not appear that Albinus was right in supposing that the nervous layer can be separated in form of a distinct membrane, though shreds of a considerable size may be detached, especially if hardened by acid or spirit.

Exclusive of these two layers, I find that the retina is covered on its external surface by a delicate transparent membrane, united to it by cellular substance and vessels. This structure, not hitherto noticed by anatomists, I first observed in the spring of the last year, and have since so frequently demonstrated, as to leave no doubt on my mind of its existence as a distinct and perfect membrane, apparently of the same nature as that which lines serous cavities. I cannot describe it better, than by detailing the method to be adopted for examining and displaying it. Having procured a human eye, within forty-eight hours after death, a thread should be passed through the layers of the cornea, by which the eye may be secured under water, by attaching it to a piece of wax, previously fastened to the bottom of the vessel, the posterior half of the sclerotic having been first removed. With a pair of dissecting forceps in each hand, the choroid coat should be gently torn open and turned down. If the exposed surface be now carefully examined, an experienced eye may perceive, that this is not the appearance usually presented by the retina; instead of the blue-white reticulated surface of that membrane, a uniform villous structure, more or less tinged by the black pigment, presents itself. If the extremity of the ivory handle of a dissecting knife be pushed against this surface, a breach is made in it, and a membrane of great delicacy may be separated and turned down in folds over the choroid coat, presenting the most beautiful specimen of a delicate tissue which the human body affords. If a small opening be made in the membrane, and the blunt end of a probe introduced beneath, it may be separated throughout, without being turned down, remaining loose over the retina; in which state if a small particle of paper or globule of air be introduced under it, it is raised so as to be seen against the light, and is thus displayed to great advantage; or it is sometimes so strong as to support small globules of quicksilver dropped between it and the retina, which renders its membranous nature still more evident. If a few drops of acid be added to the water after the membrane has separated, it becomes opaque and much firmer, and may thus be preserved for several days, even without being immersed in spirit.

That it is not the nervous layer which I detach, is proved by the most superficial examination; first, because it is impossible to separate that part of the retina, so as to present the appearance I mention; and, secondly, because I leave the retina uninjured, and presenting

the appearance described by anatomists, especially the yellow spot of Soemmerring, which is never seen to advantage until this membrane be removed; and hence it is that that conformation, as well as the fibrous structure of the retina in some animals, becomes better marked from remaining some time in water, by which the membrane I speak of is detached.

The extent and connections of this membrane are sufficiently explained by saying, that it covers the retina from the optic nerve to the ciliary processes. To enter into farther investigation on this subject, would lead to a discussion respecting the structure of the optic nerve, and the termination of the retina anteriorly, to which it is my intention to return at a future period.

The appearance of this part I find to vary in the different classes of animals and in man, according to age and other circumstances. In the fetus of nine months it is exceedingly delicate, and with difficulty displayed. In youth it is transparent, and scarcely tinged by the black pigment. In the adult it is firmer, and more deeply stained by the pigment, which sometimes adheres to it so closely as to colour it almost as deeply as the choroid coat itself; and to those who have seen it in this state, it must appear extraordinary that it should not have been before observed. In one subject, aged fifty, it possessed so great a degree of strength as to allow me to pass a probe under it, and thus convey the vitreous humor covered by it and the retina from one side of the basin to the other; and in a younger subject I have seen it partially separated from the retina by an effused fluid. In the sheep, ox, horse, or any other individual of the class mammalia which I have had an opportunity of examining, it presents the same character as in man; but is not so much tinged by the black pigment, adheres more firmly to the retina, is more uniform in its structure, and presents a more elegant appearance when turned down over the black choroid coat. In the bird, it presents a rich yellow brown tint, and when raised, the blue retina presents itself beneath; in animals of this class, however, it is difficult to separate it to any extent, though I can detach it in small portions. In fishes, the structure of this membrane is peculiar and curious. It has been already described as the medullary layer of the retina by Haller and Cuvier, but I think incorrectly, as it does not present any of the characters of nervous structure, and the retina is found perfect beneath it. If the sclerotic coat be removed behind, with the choroid coat and gland so called, the black pigment is found resting upon, and attached to, a soft friable thick fleecy structure, which can only be detached in small portions, as it breaks when turned down in large quantity. Or if the cornea and

iris be removed anteriorly, and the vitreous humor and lens withdrawn, the retina may be pulled from the membrane which remains attached to the choroid coat, its inner surface not tinged by the black pigment, but presenting a clear white, not unaptly compared by Haller to snow.

Besides being connected to the retina, I find that the membrane is also attached to the choroid coat, apparently by fine cellular substance and vessels; but its connection with the retina being stronger, it generally remains attached to that membrane, though small portions are sometimes pulled off with the choroid coat. From this fact I think it follows, that the accounts hitherto given of the anatomy of these parts, are incorrect. The best anatomists describe the external surface of the retina as being merely in contact with the choroid coat, as the internal with the vitreous humor, but both totally unconnected by cellular membrane, or vessels, and even having a fluid secreted between them; some indeed speak loosely and generally of vessels passing from the choroid to the retina; but obviously not from actual observation, as I believe no one has ever seen vessels passing from the one membrane to the other. My observations lead me to conclude, that wherever the different parts of the eye are in contact, they are connected to each other by cellular substance, and, consequently, by vessels; for I consider the failure of injections no proof of the want of vascularity in transparent and delicate parts, though some anatomists lay it down as a criterion. Undoubtedly the connection between these parts is exceedingly delicate, and, hence, is destroyed by the common method of examining this organ; but I think it is true in the following way. I have before me the eye of a sheep killed this day, the cornea secured to a piece of wax fastened under water, and the posterior half of the sclerotic coat carefully removed. I thrust the point of the blade of a pair of sharp scissors through the choroid coat into the vitreous humor, to the depth of about an eighth of an inch, and divide all, so as to insulate a square portion of each membrane, leaving the edges free, and consequently no connection except by surface; yet the choroid does not recede from the membrane I describe, the membrane from the retina, nor the retina from the vitreous humor. I take the end of the portion of choroid in the forceps, turn it half down, and pass a pin through the edge, the weight of which is insufficient to pull it from its connection. I separate the membrane in like manner, but the retina I can scarcely detach from the vitreous humor, so strong is the connection. The same fact may be ascertained by making a transverse vertical section of the eye, removing the vitreous humor from the posterior segment, and taking the retina in the forceps, pulling it gently from the choroid,

when it will appear beyond a doubt there is a connection between them.

Let us contrast this account of the matter with the common one. The retina, a membrane of such delicacy, is described as being extended between the vitreous humor and choroid, from the optic nerve to the ciliary processes, being merely laid between them, without any connection, and the medullary fibres in contact with a coloured mucus retained in its situation by its consistence alone. This account is totally at variance with the general laws of the animal economy; in no instance have we parts, so dissimilar in nature, in actual contact; wherever contact without connection exists, each surface is covered by a membrane, from which a fluid is secreted; and wherever parts are united, it is by the medium of cellular membrane, of which serous membrane may be considered as a modification. If the retina be merely in contact with the vitreous humor and choroid, we argue from analogy, that a cavity lined by serous membrane exists both on its internal and external surface; but this is not the fact. In the eye a distinction of parts was necessary, but to accomplish this a serous membrane was not required; it is only demanded where great precision in the motion of parts was indispensable, as in the head, thorax, and abdomen; a single membrane, with the interposition of cellular substance, answers the purpose here. By this explanation we surmount another difficulty, the unphilosophical idea of the colouring matter being laid on the choroid, and retained in its situation by its viscidity, is discarded; as it follows, if this account be correct, that it is secreted into the interstices of fine cellular membrane here, as it is upon the ciliary processes, back of this iris, and pecten, under the conjunctiva, round the cornea, and in the edge of the membrana nictitans and sheath of the optic nerve in many animals. Dissections are recorded where fluids have been found collected between the choroid and retina, by which the structure of the latter membrane was destroyed; the explanation here given is as sufficient to account for the existence of this fluid, as that which attributes it to the increased secretion of a serous membrane.

I take this opportunity of describing the method I adopt for examining and displaying these and other delicate parts, a method, which though simple, will, I expect, prove an important improvement in the means of scrutinizing the structure of animal and vegetable bodies. I procure a hollow sphere of glass from two to three inches in diameter, about one fourth of which is cut off at the part where it is open, and the edges ground down, so as to fit accurately upon a piece of plate glass, the surface of which is also ground; the object to be

examined is attached to a piece of wax fastened upon the plate of glass and immersed in a basin of water, with the cut sphere, which is inverted over it, of course full of water, and the whole withdrawn from the basin. The part may thus be examined under the most favourable circumstances; it floats in water, the only method by which delicate parts can be unfolded and displayed: the globular form of the vessel answers the purpose of a lens of considerable power and perfection, at the same time that it admits light in any quantity or direction to illuminate the object; and, what is of the utmost importance, a preparation of the greatest delicacy may thus be handed round a class in safety.''

Next in importance to the classical article on the layer of rods and cones, or Jacob's membrane, was that on Jacob's ulcer, which appeared in the *Dublin Hospital Reports,* Vol. IV, 1827, at p. 232, and runs as follows: *Observations respecting an ulcer of peculiar character, which attacks the eye-lids and other parts of the face. By Arthur Jacob, M. D.*

''Attempts to establish the specific character of a particular disease, however fruitless they may prove, are attended with the advantage of promoting accuracy of observation, and exciting minute inquiry. With the hope that such may, in some degree, be the case in the present instance with respect to the obscure subject of tumors and ulcers, I am induced to call the attention of surgeons to a disease, which, although probably observed by many, has never, I believe, been accurately described. I allude to a destructive ulceration of peculiar character which I have observed to attack and destroy the eyelids, and extend to the eye-ball, orbit, and face. The characteristic features of this disease are, the extraordinary slowness of its progress, the peculiar condition of the edges and surface of the ulcer, the comparatively inconsiderable suffering produced by it, its incurable nature unless by extirpation, and its not contaminating the neighbouring lymphatic glands. The slowness with which this disease proceeds is very remarkable; of three cases which have come under my observation, one, that which is represented in the annexed engraving, had existed for four years, and now presents no remarkable difference when compared with the drawing, which was executed six months ago: the eye-ball, exposed and dissected out as it has been by the ulceration, remains precisely in the same state, and the edges occupy the same situation as at that period. In another case, now also under my observation, the patient, an unmarried woman aged fifty-five, states, that the disease has existed for twenty-three years without having ever healed; her eye-ball also has been exposed by the ulceration for nearly a year,

and has not yet been totally destroyed. In the third case, that of a gentleman about sixty years of age, the disease existed for about nine years previous to his death, which took place from a different cause.

The sufferings of persons labouring under this disease do not appear to be very acute; there is no lancinating pain, and the principal distress appears to arise from the exposure, by ulceration of nerves or other highly sensible parts. In the examples which I have met, the disease at the worst period did not incapacitate the patients from following their usual occupations; the gentleman, to whom I have alluded, was cheerful, and enjoyed the comforts of social life after the disease had made the most deplorable ravages.

In two of those three cases, I have been unable to ascertain with certainty the nature of the disease at its commencement; whether ulceration was preceded by tubercle, encysted tumor, or wart. The account given by the patient from whom the drawing has been made, a poor woman aged fifty, is, that it arose from a blow, and commenced on the temple at a short distance from the external angle of the eye. The other woman, whose disease has existed for twenty-three years, says, that it was preceded by "a kernel under the skin over the eyebrow, which was not rough like a wart, and which existed for two or three years before it came to a head, when she picked it, after which it never healed." I quote her own words: it was probably an encysted tumor. In the gentleman's case the disease commenced in an old cicatrix, the consequence of confluent smallpox; it was at the inner angle of the eye, and constantly moistened by the tears, which could not escape into the nose, the *puncta* being closed.

This disease may be observed under two very different conditions, either in a state of ulceration, or in a fixed state, in which no progress is made toward healing. In this latter condition the parts present the following appearances: the edges are elevated, smooth and glossy, with a serpentine outline; and are occasionally formed into a range of small tubercles or elevations: the skin in the vicinity is not thickened or discolored. The part within the edges is in some places a perfectly smooth, vascular, secreting surface, having veins of considerable size ramifying over it; which veins occasionally give way, causing slight hemorrhage; in other places the surface appears covered by florid healthy looking granulations, firm in texture, and remaining unchanged in size and form for a great length of time. The surface sometimes even heals over in patches, which are hard, smooth, and marked with the venous ramifications to which I have alluded. This healing may take place on any part of the surface, whatever may be the original structure: in the case from which I have had this

drawing made, the eye-ball itself, denuded as it is by ulceration, is partially cicatrized over. When the ulceration commences it proceeds slowly, cutting away all parts indiscriminately which may be in the direction in which it spreads: the surface in this state is not so florid, and presents none of the glistening or granulated appearance above noticed: the pain is generally greater at this period. It appears also that there is a tendency to reparation, exclusive of the

Jacob's Ulcer.

cicatrization which I have mentioned: there is a deposition of new material a filling up, in certain places, which gives a uniformity to the surface which should otherwise be very irregular, from the nature of the parts destroyed. When the disease extends to the bones, they sometimes exfoliate in scales of small size, but more generally they are destroyed, as the soft parts, by an ulcerative process. The discharge from the surface is not of the description called by surgeons unhealthy or sanious, but yellow, and of proper consistence; neither is there more fetor than from the healthiest sore, if the parts be kept perfectly clean, and be dressed frequently. There is no fungus growth,

nor indeed any elevation, except at the edges, as already noticed, and even this is sometimes very inconsiderable. There is no considerable bleeding from the surface, and when it does occur, it arises from the superficial vein giving way, and not from sloughing or ulceration opening vessels: sometimes the surface assumes a dark gangrenous appearance, which I have found to arise from the effusion of blood beneath. I have not observed that the lymphatic glands were in the slightest degree contaminated, the disease being altogether extended by ulceration from the points from whence it commences.

After the preceding description it is scarcely necessary to state additional arguments to prove that the disease is peculiar in its nature, and not to be confounded with genuine *carcinoma,* or with the disease called *lupus* or *noli me tangere.* From the former it is distinguished by the absence of lancinating pain, fungous growth, fetor, slough, hemorrhage, or contamination of lymphatics; from the latter by the absence of the furfuraceous scabs, and inflamed margins, as well as by the general appearance of the ulcer, its progress, and history. It is equally distinct from the ulcer with cauliflower-like fungous growth, which occasionally attacks old cicatrices.

It remains to be determined whether this disease can be removed by any other means than the knife or powerful escharotics; and from the experience I have had in those cases, I am inclined to conclude that it bids defiance to all remedies short of extirpation. I have tried internally alterative mercurials, antimony, sarsaparilla, acids, cicuta, arsenic, iron, and other remedies, and locally, simple and compound poultices, ointments, and washes, containing mercury, lead, zinc copper, arsenic sulphur, tar cicuta, opium, belladonna, nitrate of silver and acids, without arresting for a moment the progress of the disease. I have indeed observed that one of those cases which is completely neglected, and left without any other dressing than a piece of rag, is slower in its progress than another which has had all the resources of surgery exhausted upon it. The success even of powerful escharotics is doubtful. Mary Sherlock, the old woman who has laboured under the disease for twenty-three years, and who is now in the Incurable Hospital, says that "a burning cancer plaster" was applied several times, seventeen years ago, and she has lately had the arsenical composition, called Plunkett's Powder, applied without any good effect. The gentleman to whose case I have alluded, had the sore healed, when it was very small, by the free application of lunar caustic, under the care of Mr. Travers; it however broke out again, and spread without interruption, until it destroyed the lids and globe of the eye, under which circumstances he, in despair, sub-

mitted himself to a popular charlatan, who, bold and fearless from ignorance, gave a full trial to escharotics: he repeatedly applied, what I understood to have been a solution of muriate of mercury in strong nitric acid, and in a short time excavated a hideous cavern, extending from the orbitar plate of the frontal bone above, to the floor of the maxillary sinus below, and from the ear on the outside, to the septum narium within; yet the unfortunate gentleman survived, but the disease preserved in every respect its original character. Mr. Colles however tells me, that in a case which came under his care before the disease had extended to the lids, he succeeded in establishing a permanent cure by the application of a powerful escharotic, covering up the eye during the operation of the remedy with gold beater's leaf.

Such is the information which I have to communicate respecting this malady: I offer it with the hope that surgeons who meet with similar examples, may be induced to give the result of their experience respecting it. Sufficient has however been ascertained to prove, that when the disease exists in a situation which admits of it, the sooner it is completely extirpated by the knife, or the actual or potential cautery, the better chance is afforded the patient of relief from a most distressing and fatal malady."

In addition to the classical articles above reproduced, Arthur Jacob wrote as follows: 1. The Eye. (*Encyclopedia of Anatomy.*) 2. Amaurosis. Ophthalmia. (*Encyclopedia of Practical Medicine.*) 3. Inquiries Respecting the Anatomy of the Eye. (*London Med.-Chir. Trans.*, XII, 1823.) 4. On the Form, Construction, and Use of a Cataract Needle of a Particular Description. (*Dublin Hosp. Reports,* 1827, pp. 214-231.) 5. Paralysis of the Ocular Muscles. (*Dubl. Med. Press*, 1841.) 6. The Pathology of the Eye as a Guide to General Pathology. (*Dublin Med. Press*, 1845.) 7. A Treatise on the Inflammation of the Eyeball. (Dublin, 1849. Elementary, but highly favored in its day.) 8. Spintheropia. (*Dubl. Med. Press,* Jan. 25, 1845, and Aug. 6, 1851.) 9. On Cataract and the Operation for its Removal by Absorption, with the Fine Needle, Through the Cornea. (Dublin, 1851. Transl. by Testelin in *Ann. d'Ocul.,* XXIX, 172-207, 1855.)—(T. H. S.)

Jacob's membrane. The rod and cone layer of the retina. See **Jacob, Arthur**, for the discoverer's original description of the parts.

Jacobson, Julius. Son of Ludwig Jacobson and younger brother of Heinrich Jacobson, both internists of note, and himself an ophthalmologist of high reputation. Born at Königsberg, Germany, Aug. 18, 1828, he studied there, at Berlin, and at Vienna, returning, however, to Königsberg for graduation in 1853. The following year he settled at

Königsberg, and in 1857 he qualified as privatdocent in ophthalmology at the Königsberg University. In 1859 he was made extraordinary, in 1872 ordinary, professor of the same subject in the same institution. Five years later a new ophthalmic polyclinic was erected for his use.

Jacobson should be remembered for his long-continued and at last successful fight for the separation in Prussian universities of the chair of ophthalmology from that of surgery. This fight he waged for very many years, and, in 1869, was partially successful: the students were examined in ophthalmology as a separate branch. In 1873 the victory was complete: in all the Prussian universities there had been effected a complete separation of chairs. Jacobson died in 1889.

His most important ophthalmologic writings are as follows: 1. Ueber Retinitis Syphilitica, etc. (*Königsberger Med. Jahrb.*, 1862.) 2. Ein Neues und Gefahrloses Operationsverfahren zur Heilung des Grauen Staares. (1863.) 3. Jahresbericht der Königsberger Augenklinik von 1877-1879. (Berlin, 1880.) 4. Ueber Sporadische und Epidemische Diphtheritis Conjunctivæ, etc. (Graefe's *Archiv*, VI.) 5. Cataractextraction mit Lappenschnitt. (*Ibid.*, XI.) 6. Intraoculärer Cysticercus. (*Ibid.*, XI.) 7. Ueber Graefe's Neueste Cataractextraction. (*Ibid.*, XIV.) 8. Klinische Beiträge zur Lehre vom Glaucom. (*Ibid.*, XXIX and XXX.) 9. Präparatorische Iridektomie und Antisepsis. (*Ibid.*, XXX.) 10. Albrecht v. Graefe's Bedeutung für unsere Wissenschaft aus seinen Werken. (Berlin, 1885.)—(T. H. S.)

Jacobson's retinitis. The diffuse syphilitic retinitis of Jacobson is a late manifestation of syphilitic infection, appearing six months to two years after the primary infection. The disease, however, may result from hereditary syphilis. It may be unilateral, but usually is bilateral.

Jacob's ulcer. See p. 1381, Vol. II, of this *Encyclopedia;* also, for the discoverer's original treatise on the subject, see **Jacob, Arthur.**

Jadelot's furrows. JADELOT'S TRAITS. JADELOT'S LINES. Markings of the face in young children, supposed to be indicative of disease: the genal, nasal, labial, and oculo-zygomatic lines.

Jaeger, Eduard von. An ophthalmologist of much ability, son of the better known Friedrich von Jaeger, and grandson of G. J. Beer. Born at Vienna in 1818, he received his chief instruction in diseases of the eye from his father. In 1854 he qualified as docent at the University of Vienna, but did not become professor till after the lapse of almost thirty years—i. e., the fall of 1883. He was the first to employ, or at all events to introduce, the ophthalmoscope as a means of determining the ocular refraction. He was also the first to discover the ophthalmoscopic appearances due to diabetes. Furthermore, he introduced

the well-known Jaeger test-types for the determination of visual acuity. Besides all this, he was a teacher of wide celebrity. His death occurred at Vienna, July 5, 1884.

Some of Jaeger' more important ophthalmic writings are as follows: 1. Ueber Staar' und Staaroperationen, nebst anderen Beobachtungen und Erfahrungen; aus seines Vaters Dr. Frederich Jaeger, und aus der eigenen Ophthalmologischen Praxis. (Pp., viii, 128, 10 pl.; Vienna, L. W. Seidel, 1854.) 2. Ergebnisse der Untersuchung des Menschlichen Auges mit dem Augenspiegel. (Pp. 319-344, 8 col. pl., in *Sitzungsb. d. k. Akad. d.' Wissensch. Math.—Naturw. Cl.*, Vienna, 1855, xv.) 3. Ophthalmoskopischer Hand-Atlas. (Pp. xviii and 236, 29 pl.; Vienna, 1869.) 4. The same. Neu bearbeitet und vergrössert von Maximilian Salzmann. (Pp., xi, 88, 31 pl.; F. Deuticke, Leipsic and Vienna, 1890.) 5. The same. 2. vermehrte und verbesserte Aufl. der neuen Ausgabe. (Pp. xv, 92, 32 col. pl., F. Deuticke, Leipsic and Vienna, 1894.) 6. Der Hohlschnitt; Eine Neue Staar-Extractions-Methode. (Pp., 23, Vienna, L. W. Seidel and Son, 1873.)—(T. H. S.)

Jaeger, Friedrich von. Father of Eduard von Jaeger and one of the greatest ophthalmologists of all time. Born at Kirchheim on the Jaxt, Sept. 4, 1784, son of the body physician to the Duke of Württemberg, he studied at Würzburg, Vienna and Landshut. At the last University he received in 1812 the degree of Doctor of Medicine and Surgery, presenting as dissertation "De Keratonyxide." Meantime, in 1808, he had gone to Vienna, and been appointed chief physician to the Austrian Army. In this capacity he served for one or two years. In 1812 he began to practise in Vienna, and, attracting the attention of Beer, was by him appointed his private assistant. In 1815 he married Beer's daughter, Theresa, and, during Beer's long sickness, lectured in his place—a function which, moreover, he continued to perform for one and a half years after Beer's death. However, he never received the chair of ophthalmology in his own right.

In 1825 he was appointed professor of ophthalmology in Joseph's Academy, a position which, for almost twenty-three years, he filled with high distinction. Prior to 1825 he conducted a small private eye-infirmary in his own residence. For thirty years he was body physician to Prince Metternich. In 1839 he founded the Turkish Department of Public Health. Three distinguished ophthalmologists were his students: his own son, Eduard, J. Sichel and Albrecht von Graefe —a distinguished trio surely. Sichel, as a result of Jaeger's most earnest solicitations, proceeded to Paris and founded the new French School of Ophthalmology.

Jaeger wrote but little. His only production, in fact, besides the

above-mentioned dissertation, was a treatise called "Die Aegyptische Ophthalmie" (Vienna, 1840). He was, however, a wonderful lecturer, and a still more wonderful operator. He possessed, moreover, great inventiveness, and his operation for trichiasis, as well as his cystotome (see p. 1665, Vol. III, of this *Encyclopedia*) iris hook (p. 5999, Vol. VIII) and lid-holder (p. 4346, Vol. VI), are in general use today.

Friedrich von Jaeger.

In 1865 Jaeger was attacked by a "rheumato-catarrhal" fever, and, after a long and painful illness, which he bore without complaint, died Dec. 26, 1871.—(T. H. S.)

Jaeger, Michael. A well-known ophthalmologist of Erlangen, Germany. Born Aug. 10, 1795, in Würzburg, Germany, he there received his medical degree in 1819, presenting, one year later, a dissertation, "Tractatus Anat.-Physiol. de Arteriarum Pulsu." After a number of scientific journeys, he qualified as docent in pathological anatomy at Würzburg. In 1822 he removed to Erlangen, accepting at that place the extraordinary professorship of pathological anatomy, as well as the directorship of the Medico-Chirurgical Hospital. For a number of years he lectured on ophthalmology.

Jaeger was a prolific writer, but his only works of ophthalmologic importance were a "Handwörterbuch der Chirurgie und Augenheilkunde" and "Klinische Beobachtungen über Augen–und Ohr–Krankheiten" (*Ammon's Zeitschr.* f. d. Ophth. V, 1-20, 1837). He died Feb. 2, 1838, of an affection of the larynx.—(T. H. S.)

Jaeger test-types. See **Examination of the eye**; as well as p. 2016, Vol. III of this *Encyclopedia.*

Jaeger's cornea knife. An instrument for making the corneal incision preliminary to cataract extraction. It consisted of a Beer's knife fixed to a handle, with a smaller blade connected with it by a button screw, so that it could be pushed forward or withdrawn. The knife was introduced, carried across the anterior chamber and through the cornea on the opposite side; then, by pressing the button, the smaller blade was pushed forward so as to complete the section of the cornea.

Jaesche-Arlt operation. See **Entropion**; as well as **Cilia, Misplaced.**

Jaesche, Georg Emanuel. A celebrated Russian general surgeon and ophthalmologist, inventor of the basic portion of the well-known Jaesche-Arlt operation for trichiasis. Born at Dorpat, Russia, Feb. 13 (25), 1815, son of the professor of philosophy at Dorpat University, he received his medical degree at the same institution. After a year of further study in Paris, Vienna, Prague and Berlin, he returned to Russia and settled as general practitioner in Minsk. A few years later he was called to Pensa as chief physician to the City Hospital in that place. In 1844 he was appointed to a similar position at Nishni-Novgorod. Here he died Dec. 9 (20), 1876.

His chief ophthalmologic writings, aside from numerous case-reports, are: 1. Ein Neues Verfahren bei der Operation von Distichiasis und Trichiasis. (*Russian Med. Times,* 1844.) 2. Beiträge zur Plastischen Chirurgie. (Mitau, 1844.)—(T. H. S.)

Jaesche, Gottlieb Emanuel. A well-known Russian ophthalmologist, younger brother of Georg Emanuel Jaesche. Born at Dorpat, Russia, Sept. 14, 1821, he received the degree of M. D. in 1847, For the next nine years he was engaged in medico-military service, being present at the siege of Sebastopol and at numerous independent battles. In 1856-7 he spent a year of study in Germany and France, chiefly under A. von Graefe, Arlt, and Desmarres. Returning to Russia, he was made physician to the Foundling Hospital at Moscow; in 1873 he removed to Dorpat, where he practised as ophthalmologist until his death. His most important ophthalmologic writing is a book entitled "Das Räumliche Sehen" (Stuttgart, 1879). He died Aug. 9, 1907, aged almost 86.—(T. H. S.)

Jaffnamoos. See **Ceylon moss.**

Jahia ben Serabi. See **Serapion the Elder.**

Jahjah ebn Serabi. See **Serapion the Elder.**

Jalite. (It.) Hyalitis.

Jamaica ginger, Amblyopia from. See **Columbian spirits**; also **Toxic amblyopia.**

Jambonné. (F.) Having the color of ham.

James, Bushrod Washington. A well-known homeopathic ophthalmologist of Philadelphia. Born at Somerton, Pa., (now a part of Philadelphia) Aug. 25, 1836, a son of Dr. David James, a graduate of the University of Pennsylvania, he received from the Hahnemann Medical College the degrees of M. D. and H. M. D. He at once engaged in practice in Philadelphia, and there continued in active service until

Bushrod W. James.

his death, long after. One of the earliest of homeopathic physicians in this country to turn his attention to surgery, he soon abandoned both general surgery and general medicine in order to become a specialist on the eye, ear, nose and throat. He was a skilful operator, and had a large practice.

For a time Dr. James was surgical editor of the *American Observer* of Detroit, and for two years surgical critic for the *Medical Investigator* of Chicago. He contributed numerous articles to the *Hahne-*

mannian Monthly of Philadelphia and to other professional journals, and was also active in literary work for the laity. Thus, among his non-professional articles may be mentioned "American Health Resorts and Climates," "Alaskana," "Echoes of Battle," "Alaska, its Neglected Past, Its Brilliant Future," "Alaska's Great Future," "Dawn of a New Era," "The Political Freshmen," and "Rise and Progress of the Masonic Veteran Associations."

Dr. James never married. He died, after a long illness, at his residence in Green Street, Philadelphia, Jan. 6, 1903, leaving the most of his real estate, together with $55,000.00 in cash, for the maintenance of the Bushrod Washington James Eye and Ear Institute. There survived him a sister, Mrs. Henrietta Moore, a brother, Dr. John E. James, and three nephews, all of them physicians.—(T. H. S.)

Jameson, Horatio Gates. An early American surgeon, of some importance in ophthalmology. Born at York, Pa., in 1788, he received his medical degree at the University of Maryland in 1813. Settling at once in Baltimore, he was soon distinguished in both the general and the special field. He was for many years editor of the *Maryland Medical Recorder*, and was the founder (in 1827) of the Medical Department of Washington College (afterward Washington University School of Medicine) at Washington, Pa. In this school he held the chair of surgery for about seven years.

Jameson's most important writing is "Observations upon Traumatic Hemorrhage, Illustrated by Experiments upon Living Animals"—a valuable work on the use of animal ligatures.

Jameson devoted considerable attention to diseases of the eye, and was widely known as an operator for cataract. He also wrote a considerable number of ophthalmologic articles.

He died at Baltimore in 1855.

Jameson's more important ophthalmologic writings are: 1. The Pathological Sympathy Between the Eye and the Larynx. (*Maryland Med. Recorder*, 1831, II, 117.) 2. A Case of Enlargement of the Eye Following the Entrance of Steel into the Eye. (*Ibid.*, p. 601.) 3. Two Cases of Ossification of the Lens with Luxation Through the Pupil. (*Ibid.*, p. 608.) 4. Amaurosis Associated with Inordinate Thirst. (*Ibid.*, p. 664.) 5. An Encysted Tumor of the Orbit. (*Am. Med. Rcorder of Phila.*, XII, 340.)—(T. H. S.)

James, Thomas. An English ophthalmologist who was born in 1856 and who, in a fit of depression, committed suicide by cutting his throat with a razor. His body was found at his home in Harley Street, London, Jan. 10, 1911, and the corner's verdict, delivered three days later, was "Suicide while temporarily insane." Dr. James was a

member of the Ophthalmological Society of the United Kingdom, and was for a time surgeon at the Central London Ophthalmic Hospital. —(T. H. S.)

Jamin's circle. A measuring device employed in demonstrating reflection, refraction, and polarization phenomena.

Jamin's interferometer. See **Interferometer.**

Janiceps. A term employed by Geoffroy St.-Hilaire to indicate a double monster with the individuals united above a common umbilicus and facing in opposite directions.

Janin de Combe-Blanche, Jean. A famous Avignonese ophthalmologist, inventor of the well known "Janin's ophthalmic ointment" and "Janin's vesicatory plaster," but especially renowned for his combination of the highest degree of operative skill with the grossest and most unblushing charlatanry. Born at Carcasonne, June 12, according to Magnus and Pagel, but, according to Truc and Pansier, July 12, 1731, he studied, first, in the Carcasonne Hospital and, later, at the school in Montpellier, where he devoted special attention to ophthalmology. In 1756 he settled in Calmette near Nimes, and was very successful. He then removed to Avignon, and, while there, began to advertise, not only blatantly but untruthfully. Here are three of these advertisements which Truc and Pansier inserted in their work, "Histoire de l'Ophtalmologie à l'École de Montpellier," taken from the *"Courrier de Montpellier"* and the *"Courrier d'Avignon."*

On the 17th of August, in the *"Courrier d'Avignon,"* Janin de Combe-Blanche advertised as follows: "M. Janin, physician-oculist, animated by zeal for assisting the unhappy, has just restored sight to a dozen poor persons who are on the common charity of this city. Some of whom had cataract or other blemishes, which had deprived them for a number of years of the power to see even the most distinct objects, and these cures have been affected by virtue of a Specific Water of his invention, which excites the admiration of connoiseurs. This happy discovery, reserved for the cares and labors of M. Janin, will cause him to be honored by posterity; he has applied himself to the understanding of simples, to the study of their properties, to the finding out about their mixtures, to the prescription of their uses and the discovery of their effects. Experience has responded to his study, and success to his hopes. He has not limited his researches; and his continual observations have given occasion to a discovery not less essential. Five persons in the same house experienced its excellent effects; these were attacked for a number of years by frequent fits of epilepsy, called vulgarly 'mal caduc,' or 'le haut mal;' and these have been completely delivered from this fearful disease. The same

sieur Janin offers his consultations to all who shall find themselves in a position to require them, with the disinterestedness and the generosity proper to a person who has always been solely occupied in securing for himself the esteem and good will of everyone. Those who consult him by letter will please be sure to prepay the postage to Avignon, place St-Didièr, where he now resides. He will tell such persons exactly what they will have to do to bring about a complete recovery."

In the same lay journal, on the 25th of October, 1757, he publishes the following even more remarkable passage: "M. Janin, physician oculist, sustains here perfectly the reputation which he has long enjoyed. The large number of cures which he has just performed with his *Eau Spécifique,* dissolving cataract and restoring sight to those who have had the ill-luck to be deprived thereof for a long time, excites the admiration of every person. Connoiseurs behold with astonishment the enduring health of those whom he has cured (announced in the Courrier on the 1st of September last), and especially the great virtues of his *Melanagogic Philules*, with which M. Janin cures radically those who are afflicted with the most violent mental diseases, even when their mania has extended to the most extraordinary things imaginable; as he has demonstrated by several persons of every age and both sexes, who had been suffering from insanity, and who are today sound in spirit and understanding. . . . The price of each vial of Specific Water (for the diseases of the eye) is six francs."

As the third and last illustration of Janin's "literature," the following passage is taken from the *"Courrier de Montpellier"* for Jan. 9, 1760: "M. Janin, physician oculist, operated on the 9th of last month in the University of this city and in the presence of a numerous assembly of connoiseurs, upon the sieur Michel, gardener, who has been deprived of sight for three years; he removed from him the cataract with so much dexterity that one would swear he had carried the manual of this operation to the highest perfection possible. He presented, yesterday, his patient to Messrs. the Chancellors and Professors of Medicine who, when they had carefully tested him, as well as a large number of spectators whom he had not had present the day of the operation, they, being perfectly convinced that the patient had recovered his sight, being able to distinguish colors and the properties of the very smallest objects which were presented to him, have accorded to M. Janin this attestation of cure under the seal of the University."

Janin, however, in spite of his quackish advertising, was a really remarkable ophthalmologist. Though no epoch-making invention or discovery can be assigned to the active ingenuity of this person, he nevertheless developed and most thoroughly amplified a very large

number of the discoveries and inventions of others. As a swift and accurate operator he seems to have had no equal. He was, moreover, a clear and forceful writer, and his books and articles were pondered deeply by all the ophthalmologists of his day. Among his more important writings, both general and ophthalmologic, are the following: 1. Observations sur une Fistule Lacrymale, Occasionné par un Coup de Feu. (1765.) 2. Observations sur Plusieurs Maladies des Yeux. (Lyons, 1768.) 3. Lettre Écrite de la Région des Morts par Daviel, ci-devant Oculiste du Roy, Actuellement Inspecteur de la Libraire des Écrite de Pluton, au sieur G(uerin), Chirurgien à Lyon,—sur les Bords du Styx. Chez la Vigilance et Compagnie, â la Vérité, 1769. (36 pp. small 8 vo. A curious affair, the authorship of which is a little doubtful.) 4. Mémoires et Observations Anatomiques, Physiologiques et Physiques sur l'Oeil et les Maladies qui Affectent cet Organe. (Lyons, 1772. This book contains an account of the very first experiments with glasses of complementary colors before the two eyes.) 5. Réflections sur le Triste Sort des Personnes qui sous une Apparence de Mort ont été Enterrées Vivantes. (Paris and the Hague, 1772.) 6. L'Antiméphitique ou Moyen de Détruire les Exhalations Perniciéuses et Mortelles des Fosses d'Aisance, etc. (Paris, 1781 and 1782.) 7. Réponse à M. O'Ryan sur le Magnétisme Animal. (Geneva and Lyons, 1784.)

Janin was ennobled in 1787, and died June 12, 1811.—(T. H. S.)

Jansen's operation. Operation for disease of the frontal sinus by removing its lower wall and a part of the anterior wall and cureting away the mucous membrane. See **Cavities, Neighboring.**

Jarre électrique. (F.) Leyden jar.

Jasminum pubescens. *Jasminum pubigerum.* The Nepal downy jasmine. The leaves, boiled in oil, are used in India and China in ophthalmia, and the root is said to be a good antidote to the venom of snakes.

Jasminum sambac. The Zambak or Arabian jasmine, also known as the white-flowered Indian jasmine. The leaves, boiled in oil, yield a balsam used in the East Indies to anoint the head in complaints of the eye.

Jatropha glandulifera. The *Jungli erendi,* a small shrub found in India. In Bombay, the juice of the plant is used as a counter-irritant to remove opacities of the cornea and thickening of the conjunctiva.

Jatte. (F.) A sort of plate or saucer used in laboratories.

Jaumes, Alphonse. A well known French ophthalmologist, who wrote an important work on glaucoma, and who, in later life, gave up ophthalmology for legal medicine. Born at Montpellier, May 9, 1839, son of Anselme François Jaumes, professor of general pathology at

Montpellier from 1850 to 1868, he received his degree in medicine in 1861, at the school in which his father was teaching. His graduation thesis, entitled "Glaucôme," was crowned by the Faculty of Montpellier, and brought to the young ophthalmologist a letter of felicitation from the Minister of Public Instruction. It was also one of the most important means of bringing to the attention of the ophthalmologic world the rather recently invented ophthalmoscope (Helmholtz, 1851), as well as the much more recently devised iridectomy for glaucoma (von Graefe, 1857).

Jaumes settled in Montpellier (having studied for a time with Sichel, Desmarres, and Follin, at Paris) and soon had a wide reputation as an operator on the eye. He was appointed, in 1866, to the extraordinary chair of surgery in the University, and, eight years later, to the full professorship of legal medicine and toxicology. The latter position he held till 1895. In 1880 he abandoned the practice of ophthalmology entirely, in order to teach and practise legal medicine. He died July 27, 1906.

In addition to the thesis on glaucoma, Jaumes' ophthalmic writings are as follows: 1. Contusion Oculaire Droite, Nevrite Optique Consécutive, Diminution Binoculaire de la Vision. (1881. Supplementary Reports, 1884 and 1891.) 2. Plaie Contuse du Cuir Chevelu, Ophtalmie, Phlycténulaire Consécutive, Perte de l'Oeil Droit.—(T. H. S.)

Jaundice. This sign of hepatic disease is sometimes accompanied by ocular symptoms. Parsons (*Pathology of the Eye*, p. 1292) records the fact that the yellow coloration of the conjunctiva may persist for years. In *icterus neonatorum* with purulent ophthalmia the pus is colored with bile, but tears never participate in the coloration. Xanthelasma is said to be commoner in jaundiced patients; Hutchinson rarely found jaundice but often disturbance of the liver. Xanthopsia, though described as of constant occurrence in jaundice, is relatively rare; Hirschberg, Moauro, and Purtscher found the lens and vitreous colored, in opposition to Moxon.

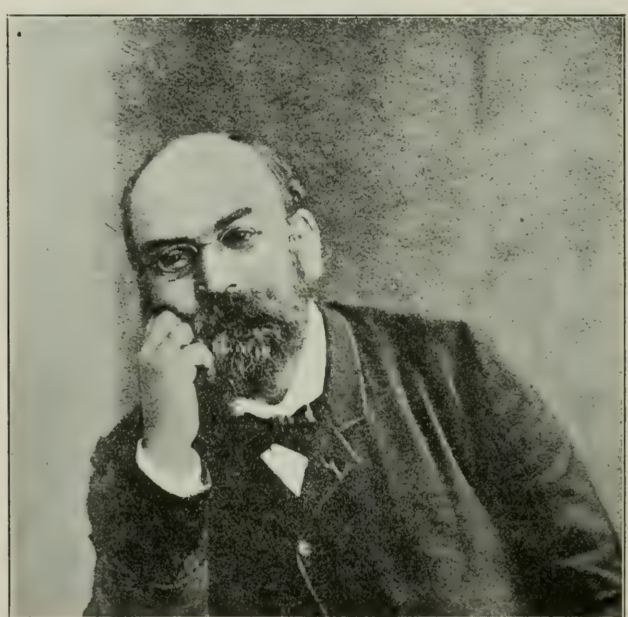
Jaune. (F.) Yellow.

Jaunisse. (F.) Jaundice.

Javal, Louis Émile. A famous Parisian ophthalmologist, blind in his later years, inventor of the Javal opthalmometer, and author of the widely known *"Manuel du Strabisme."* Born at Paris, May 5, 1839, he became, first, a student at the School of Mines and, then, an engineer. Having, one day, a commission to consult von Graefe concerning a case of strabismus in one of his near relatives, he became so touched and fired by the master's zeal and enthusiasm for medicine in general and for ophthalmology in particular, that he gave up engineer-

ing and began the study of medicine. He received his degree at Paris in 1868. Having served in the Franco-Prussian war, he turned his attention to ophthalmology.

In 1878 he became Director of the Ophthalmologic Laboratory at the School of Higher Studies, and in 1885 became a Fellow of the Academy of Medicine. He was a great investigator and teacher, but not an especially brilliant operator. In fact, his greatest services were rendered ophthalmic science in the difficult field of physiologic optics.



Louis-Emile Javal.

Most of his writings appeared in the *Annales d'Oculistique,* and are nearly of uniform value. He wrote, however, in addition to articles, the widely celebrated "Manuel du Strabisme," and, a work of even higher character, the "Mémoires d'Ophtalmometrie." There was, besides, a still more wonderful little volume, of which we shall speak hereafter. Then, too, Javal made a masterly translation into French (the first to appear in that language) of Helmholtz's "*Physiological Optics.*"

Javal was widely known as an inventor of optical instruments. The chief of these is the once almost universally employed Javal, or Javal-Schiötz, ophthalmometer. Helmholtz had invented a similar instrument which depended for its action on two glass plates. Coccius had

made an improvement by substituting for the plates a double refraction crystal. Javal retained the crystal, but improved the device as a whole most wonderfully, making it indeed (by the aid of his pupil and afterwards first assistant, Schiötz) a practical and highly useful instrument.

A Jew of the finest type, Javal was absolutely possessed by the thought of the intellectual life, by the high idealism so characteristic of his race. He was, in fact, one of the greatest scientists of his day, living, moving, and having his being in his work as ophthalmologist. Yet, like many a lesser and less faithful man, he was subject to innumerable trials and tribulations and petty and wholly unnecessary vexations. Of these the chief, no doubt, was the famous libel suit which was brought against him by a firm of (perhaps) well-meaning opticians. These people had invented a so-called "isometric" lens for spectacles, for which they claimed certain remarkable advantages. Javal, having made a careful study of the lens, "reported to the Academy of Medicine that the difference between the baryta glass [of which these lenses were composed] and ordinary glass was quite insignificant, and that the lenses were no better than those made from ordinary glass." The court decided for Javal, holding "that a scientific man is at liberty to criticise any manufactured article for which special advantages are claimed, and that his observations may be published in the public's interest."

Not long after the decision in the case, Javal began to go blind. He was suffering, in fact, from chronic bilateral glaucoma. There is something especially touching, as it seems to the writer, about the passage into darkness of any celebrated ophthalmologist. One cannot resist the feeling, in such cases, that an absolute reversal occurs of "poetic justice." That a man whose hand has given the light to hundreds of his suffering fellows, should himself be condemned relentlessly, mercilessly and inexorably to everlasting, hopeless, helpless, rayless darkness, is just about the peak and pinnacle of the irony of fate. And Javal, the greatest ophthalmologist of his nation for two decades, was subjected to just such a doom. All that human hands could do for him was done as a matter of course, and yet, in a very brief period, he was blind.

Instead of repining at his fate, this practical philosopher, as well as master ophthalmologist, began to direct his attention toward the little which he could do by way of rendering the lot of blind folk generally a trifle less unhappy. The result of his cogitations, considerations and inventions appeared at length in a precious little volume of extreme originality, entitled "*Entres Aveugles,*" or, as it is called in

the excellent English translation of Carroll Edson, "On Becoming Blind." This work was the first to appear at any time or in any language on its very important subject—that of the modes, the means, the different sorts of appliances, etc., for rendering the lot of the blind endurable—or as nearly so as possible. A strong point made in the volume was that doctors ought to *train* such patients as are certainly doomed to blindness for the ordeals which they are afterward to undergo. While the patient still retains a modicum of vision, he can learn with far greater quickness, thoroughness, and effectiveness, the things he will later need to do, than ever could be the case if his training were neglected till he once had entered the darkness. In the words of Javal himself: " . . . . they call it humane and I call it barbarous—to leave these patients in hope while amusing them with injections of strychnine, sittings of electricity, or useless internal treatment, the employment of which, even if given gratuitously, does not increase the reputation of him who makes use of them. To give, by a placebo treatment, consolation to an incurable, is to prevent him from arranging his life in anticipation of the fatal outcome." Not many years ago there appeared in a leading ophthalmologic journal a vigorous attack upon these views of Javal, the position taken being that the hopes and expectations of a person going blind are of well-nigh inconceivable value and delight to him. But the passage which I have quoted from Javal himself is a sufficient refutation of such shallow reasoning. The efforts of the placeboists are, indeed, not "humane," but simply "barbarous."

This little volume of Javal, "On Becoming Blind," though written for scientific purposes and in the style of a self-contained philosopher, possesses, I think, for all who look beneath the surface, a pathos which is really almost intolerable. In fact the very calmness with which the work is written but serves as a foil to the black, the hopeless, the despairing agony of its incidental revelations. What a desolateness of existence, for only a single example, is displayed (in the very midst of happy human intercourses at that) by the following brief passage: "What makes the position of the blind most particularly trying in company is that he does not know when his interlocutor leaves. If he has some one with him, his guide should inform him; but this is a hard task for the companion. In a salon one who speaks to a blind person, and by rare chance has taken pains to tell his name at the beginning of his conversation, never thinks to say again who he is when he comes back after a short interval. When I can, I like to take my place on a sofa which allows me to take very lightly between two fingers, quite unseen, a fold of the person's garment with

whom I am talking, and who then cannot leave without my knowing it.

"It is not given to every one to have a faithful companion who knows how to make him hear the name of whoever comes to him without affectation, and as if addressing them to wish them good day; who knows how in a conversation to make the needful remarks to save him from addressing some one who has just left or from calling him to witness; who knows how to keep him in touch with the movements of the guests, so as to save him that hateful thing, speaking to empty space."

"That hateful thing, speaking to empty space," has, in fact, been often mentioned to me by those who have long been blind as one of the bitterest of all their bitter experiences. Thus, a great giant of a man, who was more than forty years of age, and who had been quite blind for the greater portion of his life, informed me that, whenever he found himself conversing with the empty air, there suddenly arose within him such a longing and yearning as only the tender caresses of his mother could completely dispel.

So the great ophthalmologist continued both to do and to teach, even after he had calmly and serenely gone down into the valley of the shadow of blindness. In this valley of innumerable terrors, he dwelt for a number of years, always patient, always kind, and almost always genial, a source of very great pleasure to all who continued to cultivate—as many did—his acquaintance. Then, at last, on the 19th day of January, 1907, he passed into that other shadow, which, after all, as he himself might very well have put it (for he was a man of great faith in the immortality of the soul) was by no means a deepening of the darkness, but a dawning of everlasting light.—(T. H. S.)

Javal-Cuignet's test. This is one of the oldest, simplest and best methods for detecting ocular malingerers. See p. 1183, Vol. II, of this *Encyclopedia*.

Javal test chart. This test of the visual acuity is transparent and placed by the side of the patient, who looks at it in a looking-glass. We thus achieve this result, that the letters, being opaque, are always seen perfectly black, and that the distance is double by reflection. The size of the letters increases in geometrical progression.

Javal-Schiötz ophthalmometer. See **Examination of the eye**; as well as **Ophthalmometer.**

Jaw-winking. Associated movements of eyelid and jaw. To the matter on this subject given on p. 649, Vol. I of this *Encyclopedia* may here be added that it was Marcus Gunn who first described this curious phenomenon of partial ptosis with exaggerated, involuntary

movement of the affected eyelid and jaw. He presented a case to the Ophthalmological Society of the United Kingdom in 1883. Sinclair (*Ophthalmic Review*, Oct., 1895) collected a number of cases, and discusses most fully the probable meaning of the associated movements. As George Sym (*Ophthal. Review*, p. 200, July, 1908) concludes, "There does not appear to be any other probable explanation of this curious association than that in some inexplicable way there

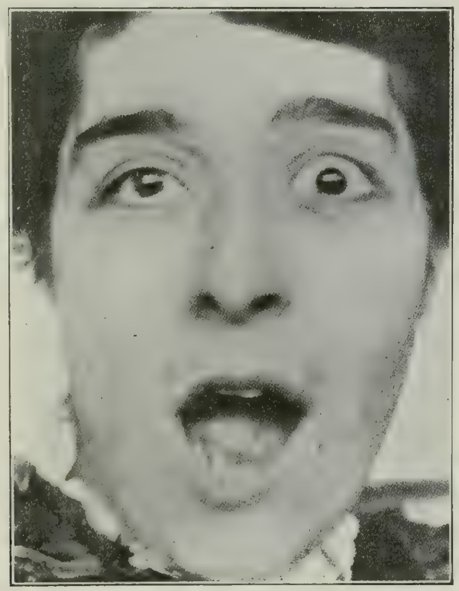
Jaw-Winking. (Sym.)
Aspect of the patient when at rest.

arises some confusion in the joining up of fibres and cells belonging to the fifth and third nuclei in such fashion that the levator receives less than its normal innervation, and there is, therefore, a certain degree of ptosis (though this is not a necessary part of the error), but there is no paralysis of the muscle, which is capable of full contraction; at the same time, the levator receives some fibres which were 'intended for' the external pterygoid or the diagastric, and when that muscle is put in action, at all events when put strongly in action, the levator is unintentionally innervated, producing the curious effect described."

L. G. Parsons (*Trans. Oph. Soc. Un. Kgdom.*, p. 113, 1910) has an interesting paper on this subject, but it is without illustrations. This lack is supplied by a well illustrated article by Thomson and Souter (*Ophthalmic Review*, June, 1912).

A. Lutz (*Klin. Monatsbl. für Augenhk.*, Jan., 1913) reports an

instance of associated movement of one upper eyelid which could alone be *voluntarily* produced. In the case of Lutz the patient was a man, 27 years of age. The phenomenon in question was first noticed at the age of five. There was slight ptosis on the right side, and, with a colored glass, diplopia could be elicited, corresponding to paresis of the right superior oblique. Elevation of the right upper lid was induced by opening the mouth, or by moving the jaw to the left side,



Jaw-Winking. (Sym.)
Aspect of the patient during sudden depression of the jaw.

but the patient could also elicit the movement voluntarily without any movement of the jaw. The latter is a peculiarity which has not been present in any of the previously published cases. It is impossible normally to elevate one lid alone. We have here a disturbance of co-ordination, which is consistent with the view that the lesion is supranuclear in the posterior longitudinal bundle of the optic thalamus. The author thinks that the disturbance of co-ordination can be best explained by assuming the loss of some normal inhibitory power. That the lesion, though supranuclear, is in the region of the nucleus, is suggested by the fact that in some cases there was paralysis of some other branch of the ocular muscles.

Jean de Carbondala. A Montpellier surgeon of the 13th and 14th centuries, who wrote a book entitled *"De Operatione Manuali,"* in which

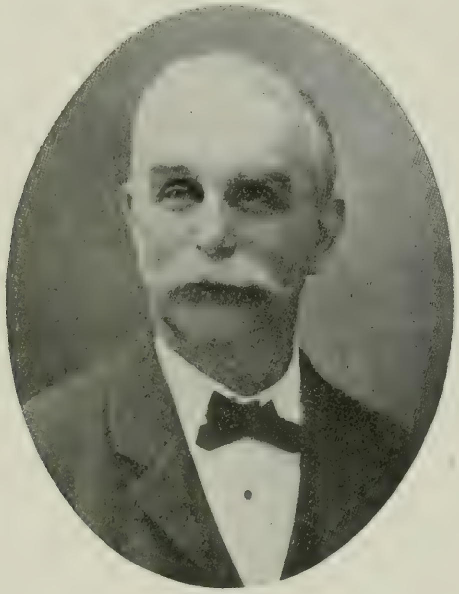
he reported a number of observations on diseases of the eye. These are of little importance, and almost nothing is known about their author. —(T. H. S.)

Jean de Tournemire. He was also known as Johannes de Tornamira. A 14th century French physician and ophthalmologist. Born at Pouzols, in the diocese of Albi, in 1329, or 1330, he began practice at Montpellier in 1348. In 1372 he was called to Avignon as physician to Pope Gregory XI; but, four years later, when Gregory quitted Avignon, Jean de Tournemire returned to Montpellier. In 1379 he again removed to Avignon, where he was made physician to Gregory's successor, Clement VII. In 1384 Clement made him chancellor of the Montpellier faculty, which position he seems to have held until his death, which occurred somewhere between 1390 and 1396.

The only writing of Jean de Tournemire of ophthalmic value is entitled *Clarificatorum in Nonum ad Almansorem* (composed at Montpellier in 1365; printed at Lyons in 1490 and again in 1500; at Venice in 1507 and again in 1521). This book contains a number of chapters on the eye, its diseases and their cure. The surgery of the eye is barely mentioned, the remedy for almost every kind of ocular difficulty being a collyrium.—(T. H. S.)

Jeffries, Benjamin Joy. A distinguished American ophthalmologist, the first to direct attention emphatically to the dangers of color-blindness, as, for example, in the railway service. Born in Boston, Mass., March 26, 1833, he came of old New England ancestry. His father, Dr. John Jeffries (1796-1876, Harvard A. B., A. M., M. D., Brown M. D.) was a very distinguished physician and close friend of Daniel Webster, who practised in Boston for more than fifty-seven years. He married Anne Geyer Amory, a descendant of Hon. Jonathan Amory, speaker-treasurer and advocate-general of South Carolina, as well as of Arthur Mackworth, one of the original patentees of Maine. Joy Jeffries' grandfather, Dr. John Jeffries (1745-1819, Harvard A. B., A. M.; Aberdeen M. D.; Harvard Honorary M. D.), was the originator (or, as some will have it, the re-introducer) of the use of cold baths and ice in the treatment of fevers. He was an ardent royalist throughout the Revolution, his house, at the outbreak of the struggle, being the royalist headquarters in America, while Jeffries himself was surgeon-general of the British forces, and a baron of the Cinque Ports. In 1785 he crossed the English channel by balloon, and was the first in history to accomplish the dangerous feat. Dr. Joy Jeffries' great-grandfather, David Jeffries (1714-1785, Harvard A. B., A. M.) who married a daughter of Chief Justice Jaffrey, of New Hampshire, was for more than thirty years treasurer of the old town of Boston. *His*

father, David Jeffries (1690-1716) was first in his class at Harvard, and *his* father, the great-great-great-grandfather of the subject of this sketch, was David Jeffries (1658-1742), the first of the family to come to America. He was born at Rhoad, Wiltshire, England, and married Elizabeth Usher, daughter of John Usher, lieutenant-governor of New Hampshire, and treasurer and receiver-general for New England, who personally paid the expenses of several Indian wars. The matter of



Benjamin Joy Jeffries.

Dr. Jeffries' ancestry is given thus much space (and might have been given a very great deal more) because of a certain historic dinner (to be mentioned again hereafter) which will long be carried in memory by the ophthalmologists of New England.

Dr. Benjamin Joy Jeffries, the subject of this sketch, received his early education at the Boston Latin School and at Harvard University, at the latter institution receiving the degree of A. B. in 1854. He then studied medicine at Harvard, receiving his degree in 1857. The next two years, which were spent in Europe, chiefly at Vienna, were devoted to the study of ophthalmology and dermatology. The teachers who mostly influenced him were von Arlt and Hebra.

Returning to America, he settled in his native city, as a specialist on diseases of the eye and skin, in which unusual combination of branches he continued for several years. Together with Dr. Francis

P. Sprague, he opened a free dispensary for the treatment of diseases of the eye and skin in Eliot Street. He was also ophthalmic surgeon to the Massachusetts Charitable Eye and Ear Infirmary from 1866 to 1902—more than thirty-six years. He was a member of the New England Ophthalmological Society, of the American Ophthalmological Society, of the Boston Society of Medical Observation, of the Boston Society of Medical History, and of the American Association for the Advancement of Science. He was also one of the founders of the Massachusetts Natural History Society. He belonged to the Somerset Club, the Thursday Evening Club and various yachting associations. At Harvard he belonged to the Porcellian Club and to the Hasty Pudding.

Dr. Jeffries married, in January, 1872, Miss Marian Shimmin. Of the union were born two children: Charles, who died during his freshman year in college, and Marian, now Mrs. James H. Means.

Dr. Jeffries was a man of sunny disposition, a fact which is well-nigh obvious from all of his published portraits. It was indeed a happy and almost prescient impulse which induced his parents to place in the very center of his name "that shining monosyllable, Joy." For joy was the central characteristic of Dr. Jeffries' being—joy for himself and joy for others also. Anyone who met him was almost tempted to think involuntarily of that old Greek form of address, *χαίρέτε, rejoice.* The Doctor, himself, in fact, was something of a punster, would sometimes joke about the monosyllabic character of his name. Thus, when yachting—a pastime of which he was very fond—he would now and then burst out to his friends, "Aha! This is what I call joy-riding—excuse me, Joy-Jeffries riding."

Dr. Jeffries was, of course, a man of strongly social disposition, and happy were those who chanced to share in his joyous hospitality. A certain gathering at his house, indeed, which occurred in 1885, has become almost a portion of ophthalmologic history. Here are the words of Dr. James A. Spalding, of Portland, Me., who was one of the guests: "In 1885 Dr. Jeffries invited the members of the American Ophthalmological Society and other prominent physicians of New England and elsewhere to a reception at his house on Chestnut Street in honor of a centennial of the day when his grandfather crossed the Channel in a balloon. It was a memorable occasion, for the house was decorated with prints and engravings of the Aeronautics of that era, and flowers were also abundant, and there was a spread. Dr. Jeffries was a delightful host. The house was, as I remember it, built with a circular staircase, and the walls along, as you went up, were decorated with balloon pictures." Another correspondent writes: "I

was present on that occasion, but please do not mention my name, as I do not now recall those days distinctly. I recall, though, the pleasant spirit of the occasion and remember that nearly all present discussed the old Indian days, the days of Dr. Jeffries' ancestors, and the older days at Harvard. 'It was good to be there.' "

According to a writer in the *Boston Medical and Surgical Journal*: "He [Dr. Jeffries] was greatly endeared to many of the surviving members of the profession and to his classmates, now reduced to seven in number. In the last few years he had undertaken the duties of class secretary. . . . He was extremely fond of the ocean and yachting, and spent many summers at Swampscott and on the shores of Hingham Harbor, and, latterly, at Marblehead."

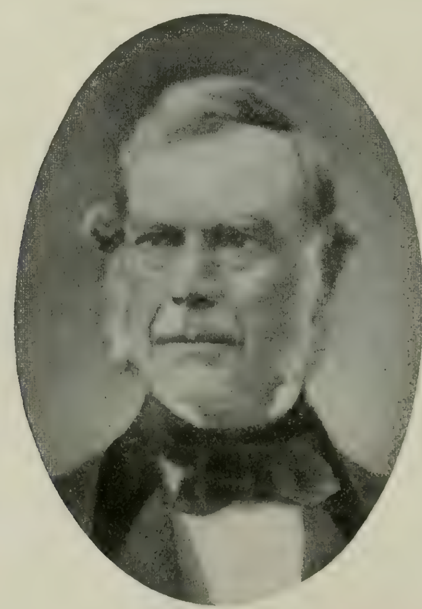
Dr. Jeffries' wife died in 1888, and since that time he lived with his daughter in the old family mansion at 15 Chestnut Street. He retired from practice in 1912, because of failing health, and passed from life, after a brief illness from pneumonia, on Nov. 21, 1915.

Dr. Jeffries was a voluminous writer. Only his works on ophthalmology, however, can here be listed.

1. I Enucleation of the Eyeball. II Section of Ciliary Nerves and Optic Nerve. III Some Unnecessary Causes of Impaired Vision. (1868, Boston, D. Clapp & Son.) 2. Report on Progress of Ophthalmology. (1871, N. Y., 8 vo.) 3. The Eye in Health and Disease. (1871, Boston, A. Moore.) 4. On Operations for Breaking up Attachments of the Iris to the Crystalline Lens, or Posterior Synechiæ. (1872, *Rept. Mass. Char. Eye and Ear Inf.*, XLVI.) 5. White Sarcomatous Intraocular Tumor. Intraocular Tumor. Two Cases of Herpes Zoster Ophthalmicus, Destroying the Eye. Traumatic Rupture of the Choroid, without Direct Injury of the Eye. (All in *Trans. Am. Oph. Soc.*, 1873.) 6. Records of 105 Cases of Operation for Cataract. (*Boston M. and S. Jour.*, 1874, XCI.) 7. Reports of Sixteen Cases of Cataract Operations. (*Ibid.*, 1875, XCIII.) 8. Incurability of Congenital Color-Blindness. (*Ibid.*, 1878, XCVIII.) 9. Lecture on Color-Blindness and its Practical Relations. (1878, Boston.) 10. Dangers from Color-Blindness in Railroad Employees and Pilots. (1878, Boston, Rand Avery & Co.) 11. Relative Frequency of Color-Blindness in Males and Females. (*Bost. M. and S. Jour.*, 1878, XCIV.) 12. Color-Blindness and its Practical Relations. (Lecture, Boston, 1878.) 13. Color-Blindness: Its Dangers and Detection. (1879, Boston, Houghton, Osgood & Co. Bound, significantly, in red and green. An authoritative work. Issued as the United States Manual on the subject in 1880.) 14. Color-Blindness Amongst the Medical Profession. (*Brit. Med. Jour.*, 1880, II.) 15. Color-Blindness; Its Examina-

tion and Prevalence. (*London Lancet*, 1880, II.) 17. Hypnotic Color-Blindness. (*Bost. M. and S. Jour.*, 1880, CII, 526.) 18. Color-Blindness and Defective Vision: Their Control. (*Gaillaird's Med. Jour., N. Y.*, 1881, XXXI, 5-12.) 19. On Some Points in Regard to Color-Blindness. (*Jour. Nervous and Mental Diseases*, N. Y., 1881.) 20. Observations on a Peculiar Expression of the Eyes in the Color-Blind. (*Tr. Internat. Med. Congress*, London, 1881, III, 121.) 21. Color-Names, Color-Blindness, and the Education of the Color-Sense in Our Schools. (*Education*, March, 1882.) 22. Our Eyes and Our Industries. (*Rep. Board of Health of Mass.*, 1882.) 23. Physical Examination of Candidates for the United States Naval and Military Academies. (*Boston M. and S. Jour.*, 1886, CXIV.) 24. Some Medico-Legal Cases Under State and National Laws. (*Tr. Am. Oph. Soc.*, 1885-7, IV.) 25. Report of the Examination of 27,927 School Children for Color-Blindness. (School Document No. 13, 1889, Boston, Rockwell & Churchill.) 26. Reports on Worsteds for Holmgren's Test. (*Tr. Am. Ophth. Soc.*, 1895.)—(T. H. S.)

Jeffries, John. A well known American surgeon and ophthalmologist, co-founder with Dr. Edward Reynolds of the Massachusetts Charitable Eye and Ear Infirmary. Born in Boston in 1796, son of Dr. John Jeffries, he received the degree of A. B. at Harvard in 1815, and of



John Jeffries.

M. D. in 1819. Dr. Jeffries was surgeon to the Massachusetts Eye and Ear Infirmary and operated there for eighteen years. He died July 16, 1876.—(T. H. S.)

Jellinek's sign. The brownish pigmentation which occurs in many cases of hyperthyroidism.

Jena glass. Glass of marked uniformity of texture, and offering in its various qualities a great variety of refractive and dispersive powers; called after the town where it was first made.

Jennings' color test. A modification of the Holmgren test. The author (*Presession Print, Oph. Sec., A. M. A.*, p. 311, 1916) fully describes and illustrates it in his article on the subject.

Jequiritin. A very poisonous principle or ferment from *Abrus precatorius.*

Jequiritol. The use of jequirity either in powder or infusion, for the treatment of pannus has unfortunately fallen into abeyance in America, mainly because of the variable dosage and its dangerous and uncertain action. Römer has sought to remedy these defects in an otherwise valuable agent by the careful manufacture, from the *Abrus precatorius* of a definite compound containing 50 per cent. glycerine, which he has called jequiritol. He believes this to be a more reliable preparation than **Abrin**, the infusion or the powdered seeds. It is made in four different strengths. The treatment begins by the instillation of a single drop of No. 1 on the first day, the dose being gradually increased in amount and strength until a well-marked jequirity inflammation is set up. Should the inflammatory reaction at any time be too severe it is controlled by dropping into the eye a small quantity of jequiritol serum (prepared on the principle of Behring's serum) repeated as often as necessary or, if the reaction be excessive, by its hypodermic use. Both remedies are prepared and sold in a box —with full directions for use—by Merck & Co. The Editor has had considerable experience with this remedy and recommends its use in pannus trachomatosus especially. See, also, p. 33, Vol. I, of this *Encyclopedia.*

Jequirity. This remedy, most useful in certain forms of chronic trachoma—especially when complicated with pannus—has been discussed under **Abrus precatorius**; **Abrin** and **Jequiritol.**

A number of reliable observers, like J. P. Worrell, who have had a wide experience of jequirity in intractable trachoma with corneal complications report that the results of treatment are most excellent.

Lawson gives the following directions for making the infusion. 100 parts of water at 120° F., are poured on eight parts of the powdered seeds. Stand until cool and decant. The seeds should be fresh; and

the freshly-made infusion is lightly scrubbed with absorbent cotton over both the lids and the cornea after cocaine (better, alypin or holocaine) has been instilled.

J. D. Seba uses the freshly-prepared infusion of the powdered bean. He begins with swabbing or flushing the everted conjunctiva with a mixture of a quarter of a grain of the powder to a drachm of distilled water. As soon as the jequirity conjunctivitis sets in the patient uses a simple borated wash every three or four hours. When the inflammation subsides he again applies the jequirity, increasing the strength of the mixture as much as is necessary to set up, again, a decided conjunctivitis.

In old cases of trachoma G. C. Savage has had marked results from the use of a weak infusion made from the powder of half a bean mixed in a fluid ounce of distilled water. To this infusion he often adds 20 grains of boric acid. Into each of the diseased eyes two drops are put daily at bed-time and the action of the drug carefully watched. A fresh infusion should be made every two weeks and the use of the remedy continued until recovery is complete.

More recently, C. J. Lukens (*Jour. Okla. State Med. Assocn.*, Jan., 1914) again calls attention to jequirity, which he prefers to use in powdered form. He has found it very useful in cases of trachoma not only where well-defined pannus existed, but also in cases with but little pannus. He says that after its use a mild boric wash is all that is necessary and that the eyes do not become "strong" for at least three months. The formation of a false membrane is desired. He gets better results, the more the swelling and edema, especially if these are followed for some time by a profuse discharge. He uses jequirity in old, indolent ulcers and phlyctenulæ, but does not attempt to employ it in cases of trachoma complicated by acute, inflammatory ulcer.

Jequirity bacillus. An organism 2.5 to 4.5 microns in length and 0.6 micron thick, found by Sattler in jequirity infusion. The shorter bacilli have terminal spores, the longer one or two central spores, and some long, filamentous forms a series of spores. The bacillus grows readily on gelatin, which it liquefies, and on various other nutritive media. It was formerly believed to be the cause of jequirity ophthalmia, but the latter is now thought to be due to the action of a soluble toxic principle (jequiritin), the bacilli being inert.

Jequirity zymase. A substance separated from a decoction of jequirity seeds, and possessing the characteristic physiological property of the drug. It is a slightly yellowish material, entirely soluble in water, and liquefying starch.

Jerubeba. In Brazil, the *Solanum paniculatum.*

Jesu Haly. See **Ali ben Isa.**

Jeune. (F.) Young.

Jimson weed. JIMPSON WEED. The *Datura stramonium.* The vulgar name is a corruption of Jamestown weed, so-called because it was early observed as a rank weed in Jamestown. It belongs to the nightshade family. See p. 3750, Vol. V, of this *Encyclopedia.*

Joannes Actuarios. See **Actuarius, John.**

Jobert de Lamballe, Antoine Joseph. A famous French surgeon, who was first to close recto-vesical and vesico-vaginal fistulas. He was also said by some to have been the inventor of "Autoplastie par glissement"—i. e., autoplasty by the sliding flap—a claim which has been vigorously contested. He was, further, a man of some importance in ophthalmology. Born Dec. 17, 1799, at Matignon (Côte-du-Nord), he received his medical degree at Paris in 1828. In 1830 he was associate to the Faculty, and in 1831 surgeon to the Hôpital Saint-Louis and consulting surgeon to the King. He was a brilliant operator, especially for cataract and the various lacrimal affections, on both of which subjects he published articles in the *Annales d'Oculistique.* He died April 25, 1867.—(T. H. S.)

Jod. (G.) Iodine.

Jodarseniklösung. (G.) Donovan's solution. See **Liquor arsenii et hydrargyri iodidi.**

Jodetum kalicum. (L.) Potassium iodide.

Jodina. (L.) Iodine.

Jodkalium. (G.) Potassium iodide.

Jodmethylphenylpyrazolon. See **Mydrol.**

Jodoformio. (It.) Iodoform.

Jodür. (G.) An iodide. The term is used generally as an affix in composition, and denotes of two similar iodides that one which contains the smaller relative amount of iodine.

Joha. An oily solution of salvarsan, marketed in ampules of 1 and 3 c.c.

Johannes de Casso. A 14th century Montpellier ophthalmologist, whose life dates are unknown. In 1346, at the request of Thomas de Corsinis of Florence, he wrote a small pamphlet called "Tractatulus de Conservatione Sanitatis Oculorum," which is, in fact, an excellent condensation of Arnold of Villanova's "Libellus Regiminis de Confortatione Visus." Johannes, however, refers to various other writers: Avicenna, Galen, Mesue, Razes, Serapion and Peter the Spaniard, all of whom are described in this *Encyclopedia.*—(T. H. S.)

Johannes de Piscis. A French physician of the 14th century, who de-

voted some attention to ophthalmology. He is not to be confounded with Johannes de Piscibus, civis Beneventanus, who, in 1396, was appointed physician to Boniface IX, nor with Johannes de Pisiis (Jean des Pois), who became a bachelor of medicine at Paris in 1395. Johannes de Piscis, the subject of this sketch, was descended from a family in Languedoc, one member of which was a bachelor of law at Montpellier, Petrus de Piscis. However, the dates of the birth and death of Johannes are unknown. Johannes wrote a *Pratica,* which, according to Truc and Pansier, was already lost in 1765. There remain, however, two fragments in the Bibliothèque Nationale, at Paris, the first of which, a so-called "antidotary," or receptaculum for formulas and recipes, contains a short division or chapter, entitled "Pour la Douleur des Yeux." The second of the fragments, which contains three chapters on the eye, is also a simple antidotary, and, moreover, is merely an extract from the works of Gérard de Solo. —(T. H. S.)

Johannes de Sancto Paulo. See **John of St. Paul.**

Johannes de Tornamira. A 14th century Monspelliansian ophthalmologist. See **Jean de Tournemire.**

Johannes, Jacobi. A 14th century physician of Montpellier, France, who devoted some attention to ophthalmology. The dates of his birth and death are not known. In 1364, however, he was appointed chancellor of the University. In 1384 he was physician to Pope Clement VII, and, shortly afterward, he died.

Four of Johannes's writings are still extant. The only one, however, containing ophthalmic matter, is the *"Secretarium Practicæ Medicinæ"* (Biblioth. Nationale, Paris, 6957 and 5988). This work, which was written in 1378 by order of King Charles V, consists of six divisions or parts, the second of which is devoted to the eye. This ocular division is again divided into ten chapters as follows: Chap. I, on Ophthalmia; Chap. II, On the Ulceration Consecutive to the Aposteme, Treatise on the Ulcer, Foreign Bodies, Leucomata; Chap. III, On Pannus; Chap. IV, On Lacrimation; Chap. V, Subconjunctival Ecchymosis; Chap. VI, On Entropion; Chap. VII, On Weakness of Vision, and on Nyctalopia; Chap. VIII, Dilatation of the Pupil; Chap. IX, On Lacrimal Fistula; Chap. X, On Cataract. The entire division devoted to the eye is extremely brief; in fact, each chapter consists of merely the barest mention of the diseases in question, followed by a suggestion of cure by some collyrium or slight mechanical procedure. —(T. H. S.)

John, King of Bohemia (1296-1346). Was crowned in 1311. Concerning this potentate there runs an historical passage of especial interest

to ophthalmologists. John was plainly going blind (and entirely lost sight in 1340.) So he sent to France for an oculist. The unfortunate eye-doctor arrived, but, proving unable to cure the monarch, he was sewn up in a sack and cast into a river. An Arabian oculist was next sent for. He, also, was unsuccessful, and would no doubt have suffered a like fate with that of his Frankish confrère, except that he had been clever enough to arrange in advance for a "safe conduct." Then the king betook himself to Montpellier, there to consult the great Guido, otherwise known as Guy de Chauliac. Guido, however, would not undertake the case. Instead, he wrote for his royal patient a little work, entitled "Manner of Life for Cataract Patients"—not now extant. The king, however, does not seem to have been greatly cheered by the volume which his calamity had called into existence, and becoming, shortly afterward, stone blind, he purposely sought and quickly found "the greater darkness still" in the battle of Crécy. —(T. H. S.)

John, Master, of Mainz. An almost wholly unknown oculist who, in 1351, operated successfully for double-sided cataract on the Abbot Gillion le Muysit at Tournay, Belgium.—(T. H. S.)

John of St. Paul. Johannes de Sancto Paulo was a medical author of the middle ages, who is said by some to have flourished in the 13th century, by others in the 12th. Some authorities have even questioned whether he lived at all. There seems to be, however, very little reasonable doubt as to his having existed, or as to his having been the author of a work called "*Liber Virtutum Medicinarum Simplicium.*" This is merely a short treatise on therapeutics, one chapter of which, entitled "De Clarificationibus Visum," consists of a mere enumeration of the commoner remedies at that time employed for the diseases of the eye. —(T. H. S.)

Johnson, Christopher Turner. The place and date of his birth are unknown. In 1809, however, he settled in Exeter, England, as surgeon and ophthalmologist. Here, too, he taught anatomy, and here he died, of a dissection wound, March 4, 1811.—(T. H. S.)

John the Actuary. See **Actuarius, John.**

Jointure. (F.) Articulation; joint.

Jones, Samuel Jones. A well-known ophthalmologist of Chicago, Ill. Born at Bainbridge, Pa., March 22, 1836, son of Dr. Robert H. Jones, a native of Donegal, Ireland, and of Sarah M. Ekel Jones of Swiss-American ancestry, he received the degree of Bachelor of Arts at Dickinson College, Carlisle, Pa., in 1857. In 1860 he received from his *alma mater* the degree of A. M. and in 1884 that of LL. D., *honoris*

causa. In 1860, at the University of Pennsylvania (to retrace a little) he received his medical degree, after a three years' course of study.

In 1860 also (the year of his graduation) he entered as Assistant Surgeon the United States Navy. On May 8, 1861, the frigate to which he had been assigned, "The Minnesota," sailed under sealed orders from Boston as the flagship of the Atlantic blockading squadron. For 21 months the Minnesota was in active service, one of her most exciting experiences being the memorable engagement at Hampton Roads with the death-dealing Merrimac on March 2, 1862. In 1867 he was assigned to duty as surgeon of the frigate Sabine. In 1868 he was promoted to the rank of Surgeon, but, before the year was out, resigned from the naval service, and proceeded to Europe, there to study ophthalmology and otology.

Returning to America, he settled in Chicago, and soon was made professor of ophthalmology and otology in the Northwestern Medical School—a position which he held for many years. In this capacity he gave clinical instruction at Mercy Hospital and at the South Side Free Dispensary. He was also ophthalmic and aural surgeon to St. Luke's Hospital. For several years he was editor of the *Chicago Medical Journal and Examiner*—a publication which prospered greatly under his management. Dr. Jones was a member of numerous medical societies, both general and special. In 1876 he was a delegate from the Illinois State Medical Society to the Centennial International Medical Congress, held in Philadelphia. In 1881 he was a delegate from the American Medical Association and the American Academy of Medicine to the Seventh International Medical Congress, which met in London. In 1887 he was President of the Otological Section of the Ninth International Medical Congress, at Washington. Dr. Jones was twice vice-president of the American Academy of Medicine, and in 1890 its president.

Dr. Jones never married. He was a large, stately man, extremely courteous and rather formal. About five feet ten inches high, he weighed 200 pounds. He was a reddish blonde, with dark-brown hair and beard, and "eyes of a dancing blue, or blue-gray." His office contained two, and sometimes three, reception rooms, for different classes of patients, and his fees were high. His only hobby was horses, and still more horses. He would never proceed to a lecture at the College or a clinic at the Hospital, except when drawn in a carriage by a team of beautiful horses. A staunch Republican in politics, he took no public part in political affairs, except in matters pertaining to the public health—especially the anti-noise crusade and the pure food propaganda. In neither of these affairs was he very successful—

a fact by no means due to any fault in himself, but rather to the obstinacy of the city authorities. His skill as an ophthalmic operator was undeniable. Dr. Jones died at Chicago, Oct. 4, 1901.—(T. H. S.)

Jones, Thomas Wharton. A famous English ophthalmologist. Born in 1808 at St. Andrews, Scotland, he studied at Edinburgh and Paris, and settled in London in 1838 as general practitioner. He was for a time Professor of Physiology at the Charing-Cross Hospital and at the Royal Institution. Later, turning his attention to ophthalmology, he became Ophthalmic Surgeon and Professor of Ophthalmology at the University College Hospital. He was particularly celebrated as an ophthalmic diagnostician. For a time he lived in retirement at Ventnor, Isle of Wight, dying Nov. 7, 1891.

Wharton Jones was a man of slight physique, yet of impressive presence, mainly because of his earnest, almost eager manner. His enthusiasm was, in fact, contagious.* Outside his lectures he was extremely shy and reserved, and to only a few was it given to be admitted to his intimacy. The poorer classes loved him, and always called him "The Old Professor." Many of the charity patients were never satisfied until they had seen "The Old Professor." If nothing else, they must at least shake hands with him. Strange as it seems, his private practice was always small, and he was, at times, poor even to the point of destitution. In the winter of 1881 he was found in a starved and almost frozen condition by one of his former pupils. The facts were reported to Dr. Ringer, Mr. Erichsen, and William Jenner, who, conjointly, and very slyly, paid in a goodly sum to Jones' credit at his former bankers. Jones was then promptly notified, and, even to his dying day, was firmly of the opinion that he had forgotten a certain sum of money which he himself, a long time previously, had deposited in the bank.

Jones' ophthalmic writings are as follows: 1. The Black Pigment of the Eye. (*Edin. Jour.*, No. 114, pp. 77-83.) 2. The Movements of the Pupil. (*Ibid.*, No. 118, pp. 10-42.) 3. *Defects of Sight: Their Nature, etc.* (London, 1856; 3d ed., 1877; edited with additions, by Laurence Turnbull, Philadelphia, 1859.) 4. *The Principles and Practice of Ophthalmic Medicine and Surgery.* (3d ed., 1865; three American editions, 3d by Prof. Atlee; one French trans. by Prof. Faucher.) This may be regarded as Wharton Jones' most important service to opthalmology. It was the leading textbook on its subject both in England and America until the appearance of *"A Treatise on Dis-*

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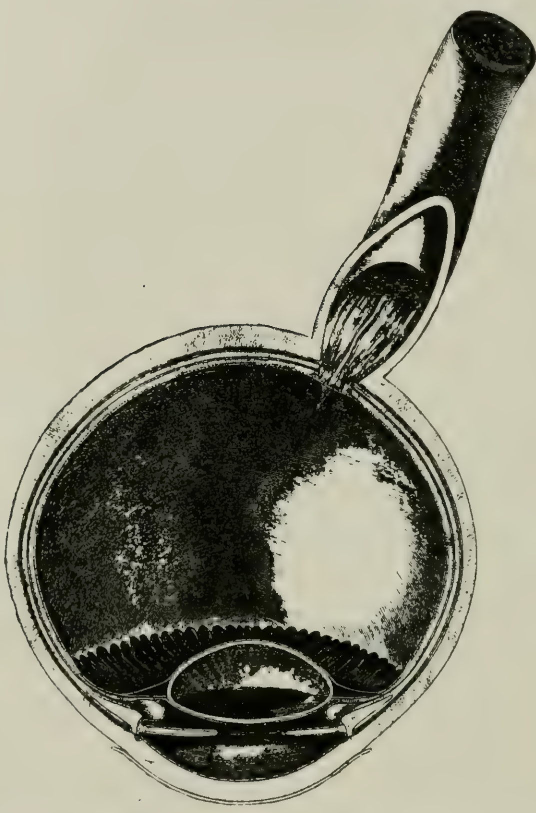
* "The true *Lumen siccum* of science glowed in every proposition which fell from the lips of the pale little man, as he stood with downcast eyes, and fingering his watch chain, at one corner of the table."—Thos. H. Huxley.

eases of the Eye," by Soelberg Wells, the first edition of which appeared in 1869. Hirschberg criticises with some severity the work of Jones, chiefly because of his failure to recognize the value of the ophthalmoscope. Aside, however, from this one great failure, the work is truly excellent, being simple, clear, and reasonably thorough.



Horizontal Section of the Right Human Eye. (As drawn by Wharton Jones.)

5. Failure of Sight from Injuries of Spine and Head. (1869.) 6. Report on the Ophthalmoscope. (*Brit. and For. Medico-Chirurgical Rev.*, October, 1854, p. 549.) In this article, also, as well as in his "Principles and Practice," Jones discloses a strange inability to appreciate the value of the ophthalmoscope. Thus, on p. 554, he says: "The little help which the therapeutics of the eye has as yet derived from the ophthalmoscope appears evident from the results of the observations contained in the works before us." In this same article, however, occurs a passage of great historic importance—the extremely belated

announcement, in fact, of Babbage's anticipation of Helmholtz in the invention of the most important instrument in ophthalmology. The passage, in full, is as follows (p. 551): "Dr. Helmholtz, of Königsberg, has the merit of specially inventing the ophthalmoscope. It is but justice that I should here state, however, that seven years ago Mr. Babbage showed me the model of an instrument which he had contrived for the purpose of looking into the interior of the eye. It consisted of a bit of plain [*sic*] mirror, with the silvering scraped off at two or three small spots in the middle, fixed within a tube at such an angle that the rays of light, falling on it through an opening in the side of the tube, were reflected into the eye to be observed, and to which the one end of the tube was directed. The observer looked through the clear spots of the mirror from the other end. This ophthalmoscope of Mr. Babbage, we shall see, is in principal essentially the same as those of Epkens and Donders, of Coccius and of Meyerstein, which themselves were modifications of Helmholtz's."
7. Wharton Jones supplied with his own hand a number of the drawings for William Mackenzie's "*A Practical Treatise on the Diseases of the Eye,*" notably the frontispiece, which is herewith reproduced, and which, in its time, was the best which had yet appeared upon the eye in a sectional view. Jones also wrote 15 pages of excellent matter in explanation of his drawing, which, also, was published in the book of Wells.—(T. H. S.)

Jonnesco's operation. Sympathectomy. See **Glaucoma.**

Josciamina. (It.) Hyoscyamin.

Joscina. (It.) Hyoscin.

Joubert, Laurent. A French surgeon of the 16th century, who devoted considerable attention to diseases of the eye, but whose writings are tinctured with the grossest superstition. Born at Valence (Drôme), Dec. 16, 1529, he studied his profession at first in his native city. Later, however, he migrated to Montpellier, there receiving the bachelor's degree in medicine, in 1551. He practised first at Aubenas, then at Montbrison. Later, he studied at Paris, Turin, Padua, Ferrara, and Bologna. In 1558 he received the degree of Doctor in Medicine at Montpellier. In 1567 he composed a competitive thesis entitled "An Visio Fiat Emittendo Potius quam Recipiendo." Shortly afterward he married Louise de Guichard. In 1583 he died at Lombert, on a journey from Montpellier to Toulouse.

His writings are twelve in number, but, with the sole exception of the dissertation mentioned, none is devoted exclusively to the eye. Here and there are brief ophthalmologic passages, but none is of any merit.—(T. H. S.)

Joue. (F.) Cheek.

Joule. This name has been used as a unit in practical electricity, to designate the work done in one second by the *ampere* or unit current flowing through the *ohm* or unit *resistance,* and is therefore, according to Joule's law the heat developed in one second in a conductor having that resistance and carrying that current. It is approximately equal to 10,000,000 ergs; so that "Joule's equivalent" (defined as the mechanical equivalent of the heat required to raise the temperature of one gramme of water from 0° C. to 1° C.) contains 4.16 *joules.*

Joule, James Prescott. This scientific investigator, one of the most distinguished experimental philosophers, was born (1818) at Salford, England. His earliest notable experiments were made with reference to electro-magnetic engines; from which he passed to quantitative determinations regarding heat, and the transformation of various forms of energy. He is justly entitled to be considered as the experimental founder of the modern theory of conservation of energy—the grandest generalization ever made in physical science. His collected scientfic papers were published (1885-87). He died in 1889, when 71 years old.

Journals, Ophthalmic. See **Ophthalmology, Literature of.**

Juengken, Johann Christian. A well-known ophthalmologist of Berlin, pupil and assistant of Carl Ferdinand Graefe and the first to perform an ophthalmic operation under general anesthesia. Born at Magdeburg, Germany, the son of a physician, he began to study medicine at Göttingen about 1812. For a time his studies were interrupted by his military services, which he rendered in a medical capacity. In 1816, however, he was back in Berlin, again at his medical studies and also assistant to von Graefe. In 1817 he received his degree, presenting the dissertation "De Pupillæ Artificialis per Coreoncion Græfianum Conformatione." The very same year he qualified as privatdocent at Berlin for surgery and ophthalmology, and, the year following, enjoyed a year of scientific travel. In 1825 he was made Extraordinary Professor of Ophthalmology at Berlin, and three years later was appointed head of the newly-founded Clinic for Ophthalmology in the Charity Hospital—a position which he held for forty years. In 1834 he became Professor of Surgery and Ophthalmology. After the reception of numerous honors of the highest character through a period of many years, he celebrated, in 1867, the semi-centennial of his doctorate. He died at Hanover, Sept. 8, 1875.

Though not a great inventor, Juengken was an excellent teacher and operator. He was a warm-hearted, clear-headed, and very helpful man, and, therefore, the idol of his students.

His most important ophthalmologic writings are: 1. Das Coreoncion. Ein Beitrag zur Künstlichen Pupillenbildung. (1818. A German translation by himself of his graduation thesis, above mentioned.) 2. Die Lehre von den Augenoperationen, etc. (1829.) 3. Die Lehre von den Augenkrankheiten, etc. (1832; 2d ed., 1836; 3d ed., 1842.) 4. Mém. sur l'Ophtalmie qui Règne dans l'Armée Belge. (Brussels, 1834. Ger. trans., same year.) 5. De Blennorrhoeis Oculi Humani. (1837.) 6. Ueber die Anwendung des Chloroforms bei Augenoperationen. (1850.) 7. Die Augendiätetik oder die Kunst, das Sehvermögen zu Erhalten und zu Verbessern. (1870.)—(T. H. S.)

Jugler, Johann Heinrich. A well-known German physician, who paid considerable attention to the eye. Born at Lüneburg, Sept. 21, 1758, he studied at Leipsic, Göttingen, Berlin, and Bützow, at the last named institution receiving his degree in 1784. His dissertation on this occasion was: "De Collyriis Veterum Variisque Eorum Differentiis." He settled first in Boizenburg; then, in 1778, at Wittingen, where he became Landphysicus. In 1795 he removed to Lüchow, and in 1809 to Lüneburg, where he died, May 27, 1812.

Jugler's ophthalmologic writings are as follows: 1. Bibliothecae Ophthalmicae Specimen Primum. (Hamburg, 1783.) 2. Opuscula Bina Medico-Litteraria: Alterum Specimen Bibliothecae Ophthalmicae Primum, Recensens Auctores, Qui usque ad Q. Sereni Sammonici Ætatem in Medicina Oculari Unquam Claruere, etc. (Leipsic and Dessau, 1785.) 3. Hippocratis de Visu Libellus. (Helmstädt, 1792.)—(T. H. S.)

Jugomaxillary. Pertaining to the malar bone and the maxilla.

Juices. A few plants, described in the various pharmacopeias, yield on expression juices that at various times have been employed in the treatment of eye diseases. These, both pharmacopeal and non-official, will be found described under their appropriate headings. They are nowadays infrequently prescribed in ocular therapy.

Jumelles. (F.) Double opera glasses.

Jumping mydriasis. This odd term has been applied to a dilatation of the pupil, at one time affecting the right pupil, and at other times the left one. The dilatation may change from one pupil to the other within an hour, a day, or within other certain intervals. This symptom was considered, by the older authors, a pathognomonic sign of paralysis and prognostically a *signum mali ominis.* The newer literature, according to E. Miloslawich (*Practical Med. Series,* p. 78, 1912) shows that this difference in the pupils occurs also in tabes, myelitis and in numerous other organic affections of the central nervous system. Jumping mydriasis is a very rare condition. It occurs in organic as

well as in such functional disorders of the nervous system as neurasthenia and hysteria.

Junction, Corneo-scleral. See **Anatomy of the eye**; as well as **Corneo-scleral margin.**

Junction, Myoneural. The point of junction of a nerve with the muscle to which it is distributed.

Junge, Eduard. A well-known Russian ophthalmologist who was born at Riga, Nov. 12, 1832, received his early professional education at the University of Moscow, and then proceeded to study ophthalmology under Albrecht von Graefe. From 1860 until 1882 he was full professor of ophthalmology at St. Petersburg, as well as a member of the Upper Military-Medical Court and Fellow of the Military-Medical Committee. These positions he resigned in 1882, for the purpose of undertaking, in the following year, the reorganization and supervision of the St. Petersburg Academy of Forestry and Agriculture. He died at Jalta, in September, 1898.

Junge wrote, in Russian: "The Mechanical Center of the Eye," and "Measures to be Taken by Troops against Conjunctivitis and Trachoma;" in German: "Zur Histologie der Glashäute," "Die Getigerte Netzhaut," "Ueber Netzhautverengerung bei Cirrhose."—(T. H. S.)

Jungstaar. (G.) Soft cataract.

Jung-Stilling, Johann Heinrich. A celebrated German poet, novelist and ophthalmologist. Born at Grund, Germany, Sept. 12, 1740, he began at first to work as apprentice at the trade of charcoal-burner, but soon tired of it and devoted himself to tailoring. Shortly afterward, though chiefly self-instructed, he became a schoolmaster. A failure in this profession, he became a private tutor; but soon determined to study medicine. In accordance with this resolution he studied from 1770-72 at the University of Jena, whither, as he states, he had gone with "half a French dollar," and where he became acquainted with Goethe, Herder, and other fellow students, who were later to become famous.

In 1772 he settled in Elberfeld as a general practitioner, devoting, however, his chief attention to ophthalmology. He was soon renowned as a highly skilful operator, but, at the end of only six years, because of the unfortunate issue of a cataract operation which he performed on the eye of a prominent citizen, relinquished medical practice and accepted an invitation to the chair of economy, finance, and statistical science at the University of Marburg. While here, however, he did not wholly abandon the practice of ophthalmology. In 1804 he accepted a similar appointment at Heidelberg. Still later he removed

to Carlsruhe, where he became a Privy Councilor. He died at Carlsruhe in 1817.

Jung's life is well described and at considerable length in Goethe's *Dichtung und Wahrheit.*

His more important writings were: "Günstige Erfolge mit dem Daviel'schen Verfahren der Cataract-Extraction, Sendschreiben an Herrn Hellman in Magdeburg, u. s. W." (Frankfurt a. M., 1775) and "Methode den Grauen Staar Auszuziehen und zu Heilen." (Marburg, 1791), both of them valuable publications. Of the novels and poems of this celebrated writer it is not in our province here to speak. —(T. H. S.)

Juniper. *Juniperus communis.* According to Pliny the elder, there were two sorts of juniper tree, the large and the small. The juice of the berries of each of these kinds, mixed with wine, was employed as a medicament in ophthalmology, being especially esteemed in epiphora and any acute inflammation attended by copious discharge.—(T. H. S.) See, also, **Cade, Oil of.**

Juno, Eye of. Buphthalmos.

Jurin, James. A London physician, of some importance ophthalmologically. Born in London in 1684, he studied at Trinity College, Cambridge, and settled as physician in London about 1712. He became, in succession, Fellow, Secretary and President of the Royal Society. He was much interested in the application of mathematics to the field of physiology; hence his attention to physiological optics. The date of his death is not known. His most important writings are: 1. Physico-Mathematical Dissertations. (London, 1732.) 2. An Essay upon Distinct and Indistinct Vision. (Cambridge, 1738: an appendix to Robert Smith's "*Optics.*")—(T. H. S.)

Jurisprudence, Ophthalmic. See **Legal relations of ophthalmology.**

Jusquiame. (F.) Hyoscyamus.

Jussiæa swartziana. A species of plant found in the West Indies, where it is used as a mild astringent and vulnerary, and especially as an application to inflamed eyes.

Justicia adhatoda. The Malabar-nut tree (or shrub); an East Indian species having bitterish, slightly aromatic leaves. The fresh flowers are applied in ophthalmia.

Justicia procumbens. A species of plant with linear-lanceolate leaves, common on pasture-grounds on the Coromandel coast, India. It is considered a remedy for ophthalmia, the juice of the leaves being squeezed into the eye.

Justus' test. Administration of mercury by inunction or subcutane-

ously, when, if syphilis is present, there will be a fall of hemoglobin of from 10 to 20 per cent.

Jute. The fibre of various species of *Corchorus;* used as a substitute for both lint and sponges in surgical dressings.

Juvenile cataract. The cataract of young persons. See p. 1554, Vol. III of this *Encyclopedia.*

Juvenile glaucoma. In addition to the observations made on page 1339, Vol. II, and p. 6083, Vol. VIII, of this *Encyclopedia,* attention is drawn to an important and rather recent contribution to the subject by Löhlein (*Bericht der Ophthal. Gesellsch.*, p. 97, 1913), who pointed out that glaucoma, apart from buphthalmos, is sufficiently common in persons under thirty-five years of age to be worthy of careful study, more especially since it varies in certain important particulars from the disease as seen in older individuals.

There is practically no histological material at disposal, so that youthful glaucoma can be investigated only from the clinical standpoint. The author has formed his views partly from the examination of ten cases of his own, and partly from the study of eighty-two published cases.

Juvenile glaucoma has as many varieties as ordinary senile glaucoma. It has no special characteristics which place it in a class separate from the disease in older subjects, differing in this respect from buphthalmos, which, as we know, is caused by a definite defect in development, such as absence of Schlemm's canal. Much as in senile glaucoma, acute cases of the disease are much rarer than chronic. Again, glaucoma simplex is commoner in myopes and emmetropes in both ages, whereas inflammatory forms appear mainly in hypermetropes. The two conditions differ, however, in three important particulars.—First, in the senile form women are chiefly affected; in the juvenile type the sufferers are mainly of the male sex, a fact which is equally true of buphthalmos. Secondly, about 15 per cent. of senile glaucomas are myopic, but 50 per cent. of the juvenile cases are shortsighted. Lastly, in the aged the proportion of inflammatory glaucomas to glaucoma simplex is 3—2; in the juvenile form 62 per cent. of all cases are instances of glaucoma simplex. According to Löhlein, forty per cent. of the juvenile cases commence between the ages of 15 and 20 years. They often remain for a long period in the prodromal stage. This peculiarity may be explained by the fact that the juvenile eye is more labile and distensible than the senile globe, and can, in consequence, tolerate high tension for a longer period than the older organ.

Three other types can be differentiated:—(1) glaucoma with a deep

anterior chamber; (2) myopic glaucoma; and (3) hereditary glaucoma.

(1) A deepened anterior chamber is found only in the juvenile disease. It is present in one-fifth of all cases of youthful glaucoma. Another fifth have a normally deep chamber. These cases are almost all instances of glaucoma simplex. Even in the hemostatic or inflammatory form, in one quarter of the examples the anterior chamber is not deeper than the normal. Most of the deepened chambers are seen in myopic eyes, a few in emmetropic eyes, but more in hyperopic eyes. The deep chamber suggests an analogy with buphthalmos; it may perhaps be a late form of this disease, and caused by developmental abnormalities, but in the absence of histological evidence, we can only guess that this may be the case.

(2) The abnormal association with myopia is a striking factor in juvenile glaucoma. The author does not agree with the commonly accepted idea that myopia confers a sort of immunity to the disease. Glaucoma is associated with myopia in about 15 per cent. of senile cases, which is about the average frequency of myopia in the whole population. There can be no question of immunity: the myopic are as liable to glaucoma as are the emmetropic and the hypermetropic.

(It is necessary to remember that Löhlein is speaking of Teutonic races. In Great Britain glaucoma is rare in myopes, and myopia is also proportionally uncommon in England and America.)

But when we come to juveniles the state of things is quite different: 50 per cent. of the cases are myopic, so that we are tempted to assume that the young myope is predisposed to glaucoma. But there are two other possibilities: first, there may be a type of glaucoma in the young which engenders myopia, or, secondly, both conditions may have a common cause. One thing is quite certain, namely, it cannot be a mere chance that the two conditions are so frequently associated.

v. Graefe suggested that glaucoma is a sequel to myopic choroiditis, but we now know that the choroidal changes are not inflammatory in nature, and so this explanation falls to the ground. The author has also noted that the high myopia found in these cases is strikingly free from changes in the fundus, an observation confirmed by Seefelder with reference to the high myopia found in buphthalmos. The clinical picture therefore affords no support to the view that the glaucoma is a direct sequence of high myopia. Ischreyt examined two cases of primary glaucoma in short-sighted eyes and found nothing which suggested that the high tension was caused by the anatomical changes characteristic of high myopia.

The second theory remains: perhaps some of the cases of myopia

grow upon the soil of juvenile glaucoma. The author has seen two cases of youthful glaucoma in which axial myopia of high degree developed, and Puech has published a similar case. The appearance of myopia in these cases should not surprise us, for we regard it as the rule in buphthalmos, and we believe that slight hypertension is a factor in the production of simple myopia. It is therefore reasonable to suppose that in some cases the high tension in infantile glaucoma is the direct cause of the myopia which so frequently accompanies it, and that in others the two conditions have a common cause.

(3) We have now to consider the influence of heredity.—Schmidt-Rimpler, in his monograph upon glaucoma, states that glaucoma is not a hereditary disease, and adds that the same remark applies to the juvenile type. Löhlein says that as regards senile glaucoma, Schmidt-Rimpler is correct in his view, but that he is in error in thinking that hereditary influences have no share in the development of the youthful variety of the disease. Löhlein finds evidence of inheritance in 20 per cent. of the cases, and thinks that, in reality, the figure is much higher. As Priestley Smith first pointed out, the anomalies which produce the disease are probably inherited, as they certainly are in buphthalmos. More than 50 per cent. of the cases have associated symptoms which we recognize to be hereditary in type. For example, cases were complicated with hyaloid arteries; with persistent pupillary membranes; with anomalies of the retinal vessels; with partial lamellar cataract; with colobomata; and with deformities of the globe, such as microphthalmos and very high myopia. Certainly, the anomalies do not in themselves predispose to glaucoma, but they suggest the associated presence of those malformations which hinder the free circulation of the intraocular fluids. Löhlein cites a family of four sisters, three of whom suffered from glaucoma simplex, while the fourth had true buphthalmos.

The conclusion Löhlein comes to is that some of the cases must be associated with buphthalmos, in so far as both are caused by inherited anomalies, while the others, and especially all cases which commence in the fourth decade of life, are examples of precocious senile glaucoma.—(Abstract in the *Ophthalmoscope*, p. 160, March, 1914.)

Haag (*Klin. Monatsb. für Augenheilk.*, Vol. 54, p. 133, 1915) has still more recently criticized Löhlein's collection of cases from the literature of juvenile glaucoma, on the ground that these published cases are in the main of an exceptional character and therefore hardly adapted for a study of the features of this form of glaucoma. He has therefore tabulated, from the material of the Tübingen clinic, 67 cases of glaucoma occurring not later than the age of 35 years.

Of a total of 1,032 cases of primary glaucoma recorded in the clinic, four occurred in the first decade of life, sixteen in the second, twenty-six in the third, seventy-four in the fourth, one hundred and seventy-six in the fifth, two hundred and eighty-eight in the sixth, three hundred and twenty-nine in the seventh, one hundred and sixteen in the eighth, and three in the ninth and tenth combined.

The frequency of juvenile glaucoma was not materially different as between the two sexes; or, in unilateral cases, as between the two eyes. In the juvenile cases diseased conditions of other parts of the body were relatively very frequent, especially general nutritional disturbances. In the sixty-seven Tübingen cases inflammatory glaucoma was about twice as frequent as glaucoma simplex; the relation in this respect being about equal in the two sexes.

Of the various refractive conditions myopia was relatively very frequent, being present in 31 per cent. of the 67 cases, and exceeding 6 D. in 17 per cent. Hyperopia was relatively rare, being present in 28 per cent. of the cases. According to these figures, therefore, hyperopia does not predispose to glaucoma, but rather myopia. Glaucoma with high grade myopia was rather commoner in the male than the female sex. Myopia was present in a larger percentage of cases of simple than of inflammatory glaucoma.

Hereditary influences do not appear (according to the cases under review) to be decidedly more frequent in juvenile than in senile glaucoma. Congenital anomalies were frequently observed in juvenile glaucoma. The records of the Tübingen material do not warrant the assumption of an essential difference between juvenile and senile glaucoma. See, also, **Congenital anomalies of the eye.**

Juvenile tabes. See **Tabes, Juvenile.**

Juvenin. A popular (German) hair dye containing an unknown percentage of paraphenylendiamin. It has acted as a decided ocular irritant, causing hyperemia and sometimes an acute inflammation of the conjunctiva.

Jyotisha. A literary production ascribed to Lagadha or Lagata, and one of the six divisions of the Brahmanical *Vedangas,* a series of treatises supplementing the original *Vedas* and *Brâhmanas.* It dates from the first centuries after Christ, and is the oldest work on astronomy, and perhaps on optics, extant.

K

K. The symbol for potassium.

For words beginning with **K** and not here given, see the corresponding heads beginning with **C.**

Ka. An abbreviation for kathode, or cathode.

Ka—. For rubrics beginning with these letters, but not found here, see the corresponding captions under **Ca.**

Kaiser, Hermann. A German ophthalmologist. Born at Erbach, Odenwalde, Nov. 20, 1815, he studied at Giessen and practised, successively, at Biblis, Ulrichstein, Seligenstadt, and Dieburg. The date of his death is not procurable.

Kaiser's ophthalmologic writings are numerous but not specially important, and deal, for the most part, with physiologic optics.—(T. H. S.)

Kaiserling's method. This method is admirably adapted to preserve the colors and transparency of ocular specimens; it is made as follows:

Formol	750.0
Distilled water	1000.0
Potassium nitrate	10.0
Potassium acetate	30.0

The specimens are allowed to remain in this solution for twenty-four hours. Transfer to 80-per-cent.-strength alcohol twelve hours. They are then placed in 95-per-cent.-strength alcohol for two hours. The preparations are preserved in a mixture of water and glycerin, equal parts, with the addition of 30 parts of potassium acetate. Very delicate objects are to remain in this mixture only for from one to two days, and are finally preserved in a mixture of equal parts of water and glycerin with the addition of a little absolute alcohol (1 to 10).—(J. M. B.)

Kakodyl. Cacodyl. Dimethylarsin; a colorless liquid, $As(CH_3)_2$, with an offensive odor. It gives off a poisonous vapor and is inflammable when exposed to air. See **Cacodylate of sodium.**

Kaleidograph. A projecting kaleidoscope.

Kaleidophone. An instrument by which the composition of vibrations is illustrated with the aid of visual persistence.

Kaleidoscope. This optical instrument consists of a tube, through whose whole length pass two mirrors hinged together along one edge, at an angle which is an aliquot part of 180°. The one end is fitted with an eyeglass, and the other is closed by two glasses at a small distance from each other, between which are placed little fragments of colored glass. The eye looking into the tube perceives these objects multiplied as many times as the angle of the mirrors is contained in 360°, and always symmetrically disposed. The slightest shaking of the instrument produces new figures.

Kali. Kalium. Potash. The Germans use the terms indifferently, as in the case of the Latin compounds, and as in our popular use of the words potassium and potash. Thus, *essigsaures Kali* and *essigsaures Kalium* are both used, although the latter is the more in accordance with modern chemical nomenclature.

Kalilauge. (G.) Liquor potassæ.

Kaliseife. (G.) Potash soap.

Kalium chloratum *vel* **chloridum.** See **Potassium chloride.**

Kalium chloricum. (G.) **Potassium chlorate.**

Kalk. (G.) Lime. This term is often used, especially by the older writers, with a qualifying adjective, to denote a salt of calcium; e. g., *essigsaurer Kalk,* calcium acetate, now written usually *essigsaures Calcium.*

Kalkbrei. (G.) Mortar, or mixed lime salts.

Kalkiger Staar. (G.) Chalky cataract.

Kalkmilch. (G.) Lime water.

Kalliblepharon. The soot obtained from resin, and employed, in ancient Greco-Roman times, as a lid-cosmetic.—(T. H. S.)

Kalmopyrin. This agent is soluble in water and contains 9.23 per cent. of calcium. It is said that (given internally) it splits into calcium hydrate or oxide and acetylsalicylic acid. Dutoit (*Oph. Year-Book,* p. 40, 1913) is favorably impressed with the effects of its internal administration in various eye diseases, especially in cases of subacute conjunctivitis, blepharitis, phlyctenular keratoconjunctivitis, episcleritis and exudative iritis.

Kalt suture. See **Cataract, Senile,** p. 1706, Vol. III of this *Encyclopedia.*

Kammerwasser. (G.) Aqueous humor.

Kampfer. (G.) Camphor.

Kangaroo tendon. See **Ligatures in ophthalmic surgery.**

Kankamon. An unidentifiable tree, the resin of which, mixed with

wine, was employed in the ancient Greco-Roman period, as a remedy for corneal scars and general weakness of the sight. According to Dioscorides the tree was indigenous to Arabia.—(T. H. S.)

Kaolin. See **Argilla.**

Kaposi's disease, Ocular relations of. LENTIGO MALIGNA. ATROPHADERMA PIGMENTOSUM. XERODERMA PIGMENTOSUM. This is a very rare disease, the etiology of which is unknown. It begins in early infancy, appearing first upon the face and hands, as minute freckle-like spots of a brown or black color, elevated, flat or nodular, which develop under the influence of light. Between these freckle-like spots are areas of depigmented skin, forming white islands. In the next stage large telangiectases appear, and finally the skin becomes atrophic, smooth, and degenerated. The skin of the eyelids is involved, and blepharitis, conjunctivitis, pigment-spots, and telangiectases of the conjunctiva and ulcers of the cornea are often present. The stage of atrophy is followed by the appearance of multiple, wart-like elevations, which undergo carcinomatous or sarcomatous degeneration. These growths arise more frequently from the eyelids than from the eyeball. They ulcerate, forming fungous masses. Early in the history of the case the eyelashes fall out. The prognosis is unfavorable, most of the patients dying early of multiple carcinoma. *Treatment* thus far has been without value. Panas and Monthus advise excision of the neoplasms, with cauterization of their bases.—(J. M. B.)

Kapselfliete. (G.) Capsule knife. Capsulotome.

Kapselhäkchen. (G.) (Lens) capsule hook.

Kapsellinsenstaar. (G.) Capsulo-lenticular cataract.

Kapselvorlagerung. (G.) Advancement of the capsule (of Tenon).

Karl Theodore, Duke of Bavaria. A celebrated ophthalmologist. See **Wittelsbach, Carl Theodore, Duke of Bavaria.**

Karyochrome. A nerve-cell the nucleus of which is stainable, while the body is not; a nerve-cell in which the stained nucleus is larger than that of a cytochrome. There are varieties designated by the Greek letters.

Karyokinesis. CARYOCINESIS. See **Daughter-nuclei.**

Karyomit. One of the small bodies into which the chromatin of a cell-nucleus splits up previous to karyokinetic division of the cell. The chromosomes of the cells of a given species of animal are constant in number. *Accessory chromosome.* A chromosome which passes entire into one of the daughter-cells instead of being divided between the two; called also *monosome heterotypical chromosome.* A chromosome which differs from an ordinary chromosome in action or appear-

ance; called also heterotypical chromosome and heterochromosome.—(Dorland.)

Käse. (G.) Cheese.

Käsiger Staar. (G.) Cheesy cataract.

Kastendampfbad. (G.) A vapor bath consisting of a case by which all but the head is inclosed.

Kataphoria. CATAPHORIA. See p. 1439, Vol. II of this *Encyclopedia.*

Katatropia. CATATROPIA. See p. 1779, Vol. III of this *Encyclopedia.*

Katharmon. A preparation of hamamelis, hydrastis, boric acid, etc.; used as an astringent and antiseptic.

Katharol. A proprietary name for two or more hydrogen dioxid preparations.

Kathetometer. CATHETOMETER. A horizontal telescope, adjustable on a vertical standard, used for the accurate measurement of small differences of level.

Kathode rays. See **Cathode rays,** p. 1782, Vol. III of this *Encyclopedia.*

Katophoria. Properly, KATAPHORIA. See **Cataphoria.**

Katotropia. Properly, KATATROPIA. A tendency of the visual axes to fall below the object looked at. See **Catatropia, Double.**

Katral. An ophthalmic lens with an aspheric surface (see *Aspheric Lenses,* under **Lenses and prisms, Ophthalmic**), designed particularly for cataract cases (aphakia). In this lens the astigmatism due to obliquely incident pencils of rays is corrected over its entire field. Therefore, the eye looking through the lens can in a perfectly natural manner secure a full angle of vision of 60°; whereas, with the ordinary cataract lens vision is confined to a limited angle. This lens is made in powers above 7 Dv. (vertex-refraction), and is the result of investigations by Dr. Moritz von Rohr, physicist of the Carl Zeiss Works, Jena, Germany, collaborating with Prof. A. Gullstrand, of the University of Upsala, Sweden. Further discussion of this subject, by the writer, will be found in the *Ophthalmic Record,* July, 1915.—(C. F. P.)

Katzenauge, Amaurotisches. Amaurotic cat's eye. See p. 287, Vol. I of this *Encyclopedia.*

Kautschukballon. (G.) Rubber bulb.

Kautschuklöffel. (G.) Hard rubber spoon.

Kawa. See **Kava-Kava.**

Kava-Kava. KAWA. AVA-AVA. This is the root of a pepper-like plant, *Methysticum methysticum,* found in Polynesia. It contains kavain and other alkaloids, used in gout, gonorrhea, rheumatism, etc. Lewin (*Ueber Piper Methysticum,* Berlin, 1886) notes cerebral symptoms and visual disturbances (especially diplopia) after the ingestion of a large quantity of watery extract of this root—the patient being dazed and

unable to name the object he sees. Persons addicted to kava drinking have red eyes, and visual acuity is lowered.

Kedani disease. An epidemic disease of Japan due to a proteus implanted (it may be, in the skin of the lid and conjunctivæ) by the bite of a mite (kedani). It is marked by fever, swelling of the lymph-glands, and an exanthematous eruption.

Keeler, James Edward, was born at La Salle, Ill., in 1857 and graduated from Johns Hopkins University in 1881. He accompanied the Colorado solar eclipse and the Mt. Whitney expeditions. In Germany he studied optics under Quincke at Heidelberg and Helmholtz in Berlin. He was assistant in the Lick Observatory in 1886 and became its astronomer in 1888; its director in 1898. Among his writings are *Spectroscopic Observations of Nebulæ.* He also wrote numerous papers for the *Astrophysical Journal.* He died in 1900.

Keeper. The armature of a magnet.

Kefir. Kephyr. A preparation of milk acted upon by a ferment derived from *bacillus caucasicus:* a nutritious and restorative food. *Arsenical kefir:* any one of a series of preparations consisting of kefir medicated with Fowler's solutions of arsenic. *Guaiacol-carbonate* kefir any one of a series of proprietary preparations of guaiacol carbonate and kefir.

Kegel. (G.) A cone; conus.

Keil. (G.) Wedge.

Keilbein. (G.) Sphenoid bone.

Keimblase. Keimhaut. Blastoderm.

Keimol. A proprietary antiseptic preparation.

Kélectome. (F.) An exploring trocar contained in a canula and having a corkscrew-like or hooked extremity, used for extracting a part of the substance of a tumor for analysis.

Kelene. A proprietary freezing mixture of the rhigoline spray order, not very practical for ophthalmic purposes. See **Anesthesia in ophthalmic surgery.**

Kelis. A skin disease marked by the formation of pinkish patches or bands, bordered by a purplish areola. The lesions are firm, but not hard, and are usually elevated or depressed. They may atrophy and disappear, leaving cicatrix-like marks. The disease is probably a trophoneurosis. Called also *circumscribed scleroderma* and *Addison's keloid.*

Keloid. Cheloid. These terms are applied to a rare overgrowth of cicatricial tissue, as well as to other fibrous or fibroid accumulations, allied to **Kelis** in the skin. It is generally "spontaneous" in origin, although usually it is traced to some pre-existing dermal lesion—like a

burn or a wound. It affects the colored race more than white patients, and is most commonly seen on the neck, chest and shoulders. It is crab-like in form; hence its name. The ocular tissues are very seldom attacked; although cases are on record in which the cornea and eyelids have suffered. *Treatment* is quite unsatisfactory; still electrolysis, radium and the X-ray have been tried and recommended. See p. 5014, Vol. VII, as well as p. 3382, Vol. V of this *Encyclopedia*.

Kenne. An old name for a concretion found in the eye of the stag.

Kennedy, Peter. A London surgeon, of the early 18th century, who, in his youth, had suffered much from sore eyes, and who, thereby, had his attention directed to the subject of ophthalmology. He wrote *Ophthalmographia, or a Treatise of the Eye* (London, 1713) and *Supplement to Ophthalmographia against Bracken, Porterfield, Cheselden, Jurin and Sharp* (London, 1739).—(T. H. S.)

Kennedy's sign. Foster Kennedy (*Amer. Journ. Med. Sciences*, Sept., 1911) calls attention to the occurrences of true retro-bulbar neuritis with the formation of a central scotoma and development of primary optic nerve atrophy on the side of the lesion, together with concomitant papilledema in the opposite eye, as an exact *diagnostic sign of certain tumors and abscesses in the frontal lobe*, namely those in which actual pressure is exerted on the optic nerve. In such cases, the initial papilledema gives way, on the affected side, to retrobulbar neuritis with progressive atrophy. Edema quickly subsides, and visual acuity diminishes rapidly, a central or paracentral scotoma develops, and in a few days' time well marked temporal pallor will be seen ophthalmoscopically; an expression of atrophy, which at a later period will be observed in all four quadrants of the disc.

Kentrokinesis. (L.) A term applied by Ferrier to indicate excito-motor action.

Kephalose. A French headache remedy.

Kepler, Johann. See **Keppler.**

Keplerian telescope. A form of refracting telescope, having a short-focal convex lens as an eyepiece.

Keppler (or Kepler), Johannes. This immortal theologian, astronomer and physicist, was born Dec. 27, 1571, at Weil, in the duchy of Würtemberg, Germany. He received his bachelor's degree at Leonberg, and, in 1588, entered the University of Tübingen, with the intention of becoming, ultimately, a minister. Here he received instruction in the new Copernican astronomy of the great Michael Maestlin. Thus far he had felt but little inclination for natural science. In 1594, however, being offered the chair of astronomy in the school at Gratz—a Lutheran institution—he accepted, and, soon after, was

"immersed in the science of the stars." In 1598, owing to the edict of the Archduke Ferdinand, directed against all Protestant preachers and professors, he fled to Hungary. In 1600, at the invitation of his friend, Tycho Brahé, he departed for Prague, there to become the assistant of this celebrated astronomer. The association, however, proved to be uncongenial. Keppler was irritable and supersensitive, and the elder man was snobbish and overbearing. Tycho Brahé died in 1601, and, from that time forward, Keppler shone as the bright particular star of the astronomical heavens.

In 1630, after a long and exhausting horseback journey, he died at Ratisbon, aged only 59. What wonders might he not have accomplished, given more time.

It is absolutely unnecessary here even to enumerate the astronomical achievements of Johannes Keppler. To think of the man himself, is to think also of his astounding astronomical discoveries and inventions. His services, however, to the world of ophthalmology—which are almost all expounded in his two great optical works, "*Ad Vitellionem Paralipomena*" (1604) and "*Dioptrics*" (1610)—are very little known even to ophthalmologists. To be as brief as possible, and yet convey some definite idea of the nature and extent of these services, we may state, formally, that the following optical facts, either absolute or approximate, were by him expressed either for the very first time, or else for the first time clearly and distinctly.

1. A retinal image consists of as many couples, or pairs, of light-cones (placed base to base at the lens), as there are points in the object looked at. (Keppler did not, contrary to the assertion of Baas, in his "*History of Medicine*," Eng. trans. by Henderson, p. 539, "recognize the function of the lens as a part of the optic system of the eye, thus overturning the entire doctrine of the ancients which had hitherto prevailed, that sight took place by means of the lens." This work was done by Maurolycus in 1597, in his great work entitled, "*Photismi de Lumine et Umbra*," and Plater, soon afterward conceived and published the notion of the screen-light function of the retina.)

2. The central point of the retina possesses the sharpest vision.

3. Eccentric vision does not give satisfaction, but merely invites the eye to turn in this or that direction for the purpose of securing a sharper view.

4. It is the vitreous humor that holds the retina taut.

5. The crystalline humor presents, behind, a hyperbolic surface, in front, a spherical—which produces a better refraction.

6. Every eye possesses a point, externally, of sharpest vision. The

bundle of rays which sets out from this point, unites in a point again upon the retina. Every object which lies beyond this point, appears to be indistinct.

7. Eyes that see far objects plainly, but near ones dimly, are helped by convex lenses.

8. Those, on the other hand, which see far objects dimly, but near ones plainly, are benefited by concave glasses.

9. The convex lenses assist by altering the rays which pass to the eye from near objects in such a manner that they become like to those which proceed from objects more remote.

10. The concave lenses, on the contrary, alter the rays which come from distant objects in such a fashion that they seem to proceed from points that are near at hand.

11. Without the concave lenses, rays which come from a distant point would intersect one another in front of the retina, and, having still farther to proceed, would disperse themselves into a certain breadth, instead of a sharp point.

12. When sunlight shines upon a prism, there arise three kinds of rays: (1) the unchanged; (2) those of the color of the glass; (3) rainbow colored.

13. A plane-sided right-angled prism does not permit the rays falling parallel to a cathetus to pass through.

14. An object looked at through a prism, appears to have been moved in the direction of the edge.

15. Every distant point emits rays in all directions. As to the eye, however, or as to any lens, whose diameter is negligibly little in comparison with the distance, the most external of the rays which strike upon the eye or the glass, may be regarded as parallel.

16. Of all the rays in any pencil that impinges on a curved surface, only one can be regarded as vertical thereto.

17. Rays proceeding from a near point, diverge as they pass toward the pupil of the eye. Of rays proceeding from different points on the same object, however, many necessarily converge as they move toward the eye. One should carefully distinguish between the bundle of rays emitted by a single point, and the different rays sent out by several points.

In addition to establishing all these highly important facts, Keppler also considerably enriched the optical nomenclature. Thus, to him, we owe—at least in their optical acceptations—the terms, *prism, lens,**

* The crystalline body, or humor, of the eye, was first denominated ''lens'' by Govert Bedloo, of Amsterdam, in 1685.

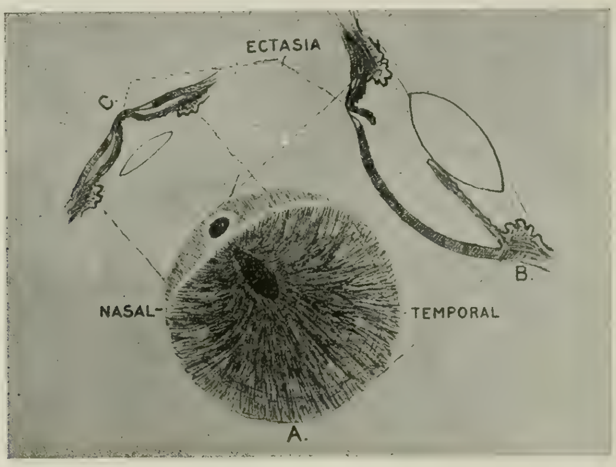
and *meniscus.* "Prisma," before his time, meant, simply, "sawing-block;" "lens" meant a "lentil;" and "meniscus," the "half-moon."

Altogether, we may say that no one, probably, has done so much, even to the present day, for the furtherance of optics, physical or physiological, than did Johannes Keppler.—(T. H. S.)

Kerat-. See, also, **Cerat-.**

Keratalgia. Pain in the cornea.

Keratectasia. STAPHYLOMA OF THE CORNEA. KERECTASIA. ECTASIA OF THE CORNEA. KERATOGLOBUS. This condition is characterized by varying degrees of bulging of the cornea—usually partial—which follows inflammations or other states affecting the deeper corneal layers unaccompanied by perforation or incarceration of the iris. The corneal



Bilateral Marginal Thinning and Keratectasia with Perforation on One Side. Left Eye. (Schutz.)

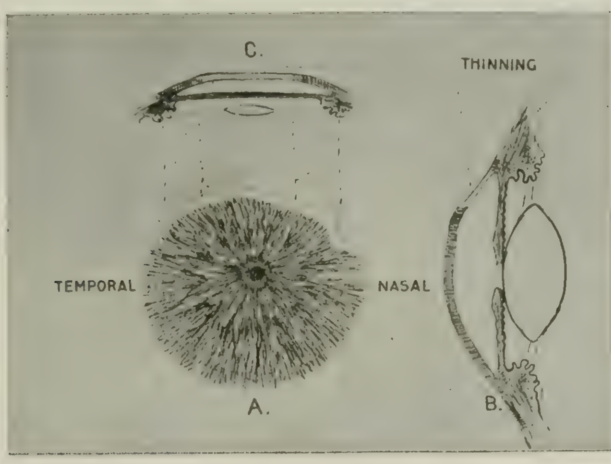
ectasis may occur as a result of ulceration which has destroyed the superficial lamellæ so that the remaining posterior laminæ are unable to resist the intra-ocular tension (*keratectasia ex ulcere*). In some cases of ulceration of the cornea, Descemet's membrane escapes destruction and protrudes (keratocele) as a persistent translucent vesicle surrounded by an opaque ring. In pronounced cases, the hernia may rupture when this occurs. The condition presents a clinical picture not unlike buphthalmia. In keratitis parenchymatosa, there is probably always some distension of the cornea. In severe cases, the softening and thinning of the cornea is well pronounced and when accompanied by increased intra-ocular tension, the bulging of the weakened cornea is considerable and generally quite uniform. In some cases of

pannus, usually granular, in which the inflammatory process penetrates the substantia propria, the cornea will lose its normal curvature as a result of the impaired resistance produced thereby (*keratectasia e panno*).

Partial keratectasia may occur in rare instances following marginal and filamentous keratitis. The cicatrix then shows some thinning with destruction of Bowman's membrane, which is replaced by a thickened epithelial layer covering the underlying scar tissue.

Marginal keratectasia call for special mention, in addition to the references to them on p. 3360, Vol. V, of this *Encyclopedia*.

Terrien (*Archives d'Ophtalm.*, p. 12, 1900) was among the first to recognize this condition, although Fuchs (*Archiv f. Ophthalm.*, p.



Kerectasia with Bilateral Marginal Thinning. Right Eye. (Schutz.)

327, 1901) carefully described several cases soon afterwards. J. Herbert Fisher (*Ophthalmic Record,* Nov., 1909), reports a typical bilateral case, in a female, æt. 41. The right eye had been inflamed 15 or 16 years before. The vision in the right eye was $6/60$, and that of the left $6/6$. The corneal curvature was distorted by great stretching of an upper marginal segment of crescentic shape, the stretched segment being limited towards the corneal tissue by a well-marked, greyish-white line, not unlike an arcus senilis. Fisher was of the opinion that this line really represents the inferior limit of the natural scleral arc, and therefore that the stretched crescents correspond to the marginal vascularized part of the normal cornea. The stretched segment formed almost an angle with the normal corneal tissue, and at the highest point, its widest part, was roughly twice as wide in the

right as in the left eye, the actual measurements being 4 mm. and 2½ mm. respectively. In other respects the eyes were healthy.

The results of a pathological examination of specimens from Fisher's case are given by Coats (*Trans. Oph. Soc. U. K.*, p. 5, Vol. 31, 1911). The illustrations in the text of this heading are from the article by Schultz (*Archives of Ophthalm.*, p. 368, 1911). To all these articles the reader is referred for more detailed information on this subject.

Treatment of corneal ectasiæ is effective only when instituted in the formative stage. Paracentesis, repeated as often as conditions indicate and followed by pressure bandages, may prove effective when keratectasia is detached in its incipiency. When the ectasis is small, as, for instance, in keratocele, perforation, effected by the cautery point and long continued pressure bandaging, may induce a flat cicatrix. In other cases, iridectomy or sclero-corneal trephining are the only alternatives which are effective. In cases of keratectasia of luetic origin specific treatment will frequently control the condition.

The use (referred to elsewhere) of epinephrin in limiting the spread of corneal ectasia is advised by Pontius (*N. Y. Med. Jour.*, Sept. 28, 1912). See, also, p. 3467, Vol. V, and p. 3399, Vol. V, of this *Encyclopedia;* as well as the headings indicated by the synonyms at the head of this section.—(J. D. L.)

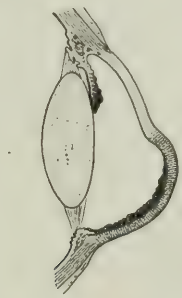
Keratectomy. Excision of the cornea. Ceratectomy. Kerectomy. Cerectomy. Abscission of the cornea. The usual operative acts involved in the removal of a part or the whole of the cornea are depicted and described on p. 37, Vol. I of this *Encyclopedia.*

Borghetti (*Pract. Med. Series, Eye*, p. 75, 1909) advises the following: Detach the conjunctiva from the sclerotic all round, and as far back to the extent of 1 centimeter. Pass a suture all round the conjunctiva close to its margin. A second purse-suture is placed a few mm. behind the corneal margin, including the episcleral tissue as well as the superficial fibers of the sclerotic, the suture being a buried one all round except at the lower part of the eyeball, where the two ends of the thread should pierce the conjunctiva and rest on the external side of this membrane. By pulling upon the two ends of the thread the eye is fixed, and by means of a cataract knife a flap is cut upward, equal in size to four-fifths of the tissue to be removed. As this goes on, the two ends of the suture are pulled upon more and more, so that no sooner has the knife accomplished the cut upward than the wound is closed and the loosened flap, still adhering to the lower part of the eyeball, is ready to be snipped off level by a stroke of the scissors. The conjunctiva is next brought in front of the eye as in de Wecker's

operation. The suture holding the sclerotic is loosened to prevent the ciliary nerves suffering compression, and the two ends of the thread are knotted. The author claims for this operation:

1. The ciliary nerves suffer no pressure and there is no fear of sympathetic ophthalmia. 2. This method can be applied where other methods cannot, and even when chloroform is contraindicated, or when intelligent assistance is not easily found. 3. An artificial eye can be placed on the stump, which moves freely in all directions.

S. Lewis Ziegler (*Jour. Am. Med. Assocn.*, p. 839, Vol. 63, 1914) very properly contends that when a protruding but circumscribed corneal ectasia has proved to be more or less obstructive to the vision, and the remaining tissues of the globe have not been seriously involved in the pathologic process, conservative surgery demands that a



Keractectomy. (Ziegler.)

Vertical section of anterior staphyloma, showing clear cornea above and ectasia below. The thickened iris-tissue has been glued to the cornea by plastic inflammation.

mobile globe shall be preserved, and, whenever it is possible, that a modicum of useful vision shall be secured.

To meet these indications he devised, in 1895, a simple form of corneal excision, which he designated trefoil keratectomy. It is adapted chiefly to those cases in which a limited portion of the cornea is staphylomatous and in which correction of the ectasia can be made by the removal of a three-leaved flap from the lower part of the pendulous cornea. (See the figure.) When, however, the whole cornea is involved and a four-leaved flap must be excised to correct the deformity, the procedure is designated as stellate keratectomy.

Full antiseptic precautions should be observed, and although the operation has been performed under cocain-epinephrin anesthesia, full ether narcosis is to be preferred.

There are three methods, (a) trefoil keratectomy with the scissors,

(b) trefoil keratectomy with the punch and (c) stellate keratectomy with both scissors and punch.

Trefoil keratectomy with scissors. With the speculum inserted and the globe firmly held by fixation forceps, the operator should first inspect and outline the exact area to be excised. (See the figures.) The Graefe knife is then passed horizontally through the base of the staphyloma from the temporal to the nasal side, keeping the edge of the blade turned directly forward, as for a Saemisch incision, and drawing it backward and forward but not allowing it to emerge fully until the aqueous fluid has completely escaped.

One blade of the scissors is now introduced beneath the upper margin of the horizontal incision, a little to the right of the center

Keratectomy. (Ziegler.)

Corneal punch, with long oval points. The spring was adapted from McClure's iris scissors.

(2 or 3 mm.), and a long vertical incision made. A second converging cut is then made, the same distance to the left of the center, which joins the first at the apex and thus makes a V-shaped incision and opening.

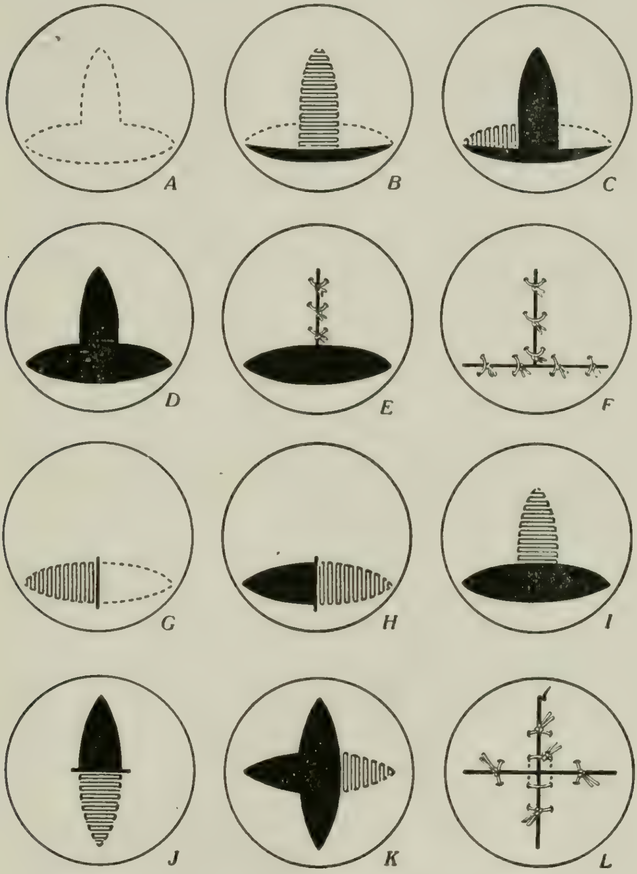
The two corners of the opposing wound-margins are successively grasped with the forceps and a triangular piece excised by scissors from each corner, thus making a three-leaved opening.

The vertical wound is closed by two or three fine black silk sutures passed through the opposing wound-margins and tied. The horizontal wound is then sutured in like manner.

A Kalt suture (linen) may, if preferred, be inserted through the outer layers of the cornea and tied as a mattress-suture. The cut surfaces must be carefully approximated at all points.

Punch method of keratectomy. A vertical incision is made through the base of the staphyloma with an angular keratome, and the inferior blade of the punch is passed into the anterior chamber and beneath the cornea, while the punch is closed with a short, quick thrust, thus excising the left lateral flap.

The punch is removed, introduced on the other side of the wound-edge, and the right lateral flap is excised in the same way.



Various Stages of Ziegler's Keratectomy.

Incisions and sutures for both trefoil and stellate keratectomy; *A*, three-leaved flaps outlined; *B*, corneal incision below, *à la* Saemisch, shaded part of upper flap ready for removal; *C*, upper flap excised, left tip shaded; *D*, trefoil keratectomy completed; *E*, vertical wound sutured; *F*, both vertical and horizontal wounds sutured; *G*, vertical keratome incision for punch operation, left flap shaded; *H*, left flap excised, right shaded; *I*, right and left flaps excised, upper flap shaded; *J*, horizontal keratome incision for stellate keratectomy, upper flap excised, lower one shaded; *K*, upper, lower and left flaps excised, right flap shaded for removal; *L*, stellate keratectomy completed and sutures inserted.

The upper margin of this long, oval wound is now grasped at its center by the punch and a vertical piece excised, leaving a trefoil opening.

The sutures are now inserted to close first the vertical wound and then the horizontal wound, as previously described.

Stellate keratectomy. This operation is chiefly indicated when the staphyloma involves the whole of the cornea, or when a central mushroom staphyloma has developed. It can be performed either with the knife and scissors or with the keratome and punch, as is preferred.

A horizontal incision is made in the center of the cornea, with the Graefe knife or with the keratome.

The upper and lower vertical flaps are excised with the scissors or with the punch. In like manner the two horizontal flaps are excised.

Each section of the stellate incision is closed by a single suture, and a central mattress-suture is finally inserted.

Occasionally complications arise. If, by chance, abnormally high tension should cause extrusion of the lens, or if vision can be improved by the removal of a cataractous lens, the loop or the silver spoon should be used for this purpose and the toilet of the wound made before tying the sutures. If it seems possible to improve the vision by iridectomy or by de Wecker's irito-ectomy, this may be done before the wound is closed, but pari passu, it is better to postpone such an attempt until after healing has occurred.

As *postoperative treatment,* there should be proper disinfection of the conjunctival cul-de-sac and a light bandage with a cresol solution compress adjusted. A slow-healing wound may be stimulated by touching it with a weak solution of silver nitrate. An infected wound should have an application of liquor formaldehydi, 0.5 per cent., and ice-pads should be applied. A wound that slightly gapes or shows other irregularity should receive a gentle touch with the galvano-cautery.

The therapeutic value of keratectomy in corneal abscess is discussed on p. 3331, Vol. V of this *Encyclopedia.*

Keratinian. Pertaining to the cornea.

Kératite des moissonneurs. (F.) REAPER'S KERATITIS. HARVESTER'S KERATITIS. A form of traumatic keratitis induced by contact of beards of grain with the cornea.

Kératite en bandes. (F.) KÉRATITE EN BANDELETTES. Band-shaped keratitis.

Kératite pointillée. (F.) Keratitis punctata.

Kératite professionelle. (F.) Occupational keratitis.

Kératite quadrillée. A synonym of grill-like keratitis.

Keratitis. KERATITIS IN GENERAL. INFECTIONS OF THE CORNEA. INFLAMMATION OF THE CORNEA. CORNEITIS. According to Uhthoff, more than thirteen per cent. of blindness, exclusive of gonorrheal ulcera-

tions, is traceable to inflammatory affections of the cornea; about fourteen per cent. being the result of gonococcal infections—a total of twenty-seven per cent. of all blindness is, therefore, the result of some form of keratitis. See also the various **Cornea** rubrics in Vol. V of this *Encyclopedia.*

"Bowman (1849) first drew attention to the minute changes in the cornea in inflammation, and he was followed by Virchow (1852) and his pupil Strube (1851), His (1856), Weber (1858), Rindfleisch (1859), and Langhans (1861). At this period, only the fixed corneal corpuscles were known, and all cellular changes were attributed to them, though their dependence for nutrition upon fluid (lymph) exuded from the peripheral blood vessels was recognized (Virchow, 1843). The discovery by v. Recklinghausen (1862) of wandering cells, resembling white corpuscles, altered the whole aspect of the subject, and the enormous increase of cells in inflammatory conditions could no longer be attributed, without further proof, to the corneal corpuscles. v. Recklinghausen placed pieces of cornea in the lymph-sac of a frog, and found that they were rapidly permeated with cells; and since this took place in absolutely dead corneal material, it was obvious that the cells were derived from without. Moreover if particles of cinnabar were placed in the lymph-sac, they were taken up by the cells, and were also present in the intra-corneal cells—a further proof that these had wandered into the tissue.

Cohnheim (1867-1873) showed in a series of experiments that white corpuscles leave the blood vessels in large numbers during inflammation, and wander at large in the tissues. By marking the leucocytes with cinnabar (v. Recklinghausen) or aniline blue (Cohnheim) it was possible to demonstrate that they wandered into the cornea *in situ*, in the same manner as into the dead cornea in the frog's lymph-sac. Cohnheim went too far in denying any activity in the corneal corpuscles, an opinion which met with vigorous and insufficiently restrained opposition from Stricker, Böttcher, and others.

Eberth (1876) paid special attention to the part played by the corneal corpuscles in regeneration, which was also investigated by Senftleben (1878), who considered that the corpuscles only reproduced themselves, and never gave origin to pus-corpuscles. Ranvier thought that the function of the leucocytes in corneal wounds was to afford nourishment to the proliferating corneal cells.

Stricker had already asserted the activity, not only of the corneal cells, but also of the ground substance; and Heitzmann affirmed the presence here of living material which, during inflammation, returned to an embryonic cellular condition. Grawitz went so far as to assert

the presence of "sleeping" cells, which awoke to activity under the stimulus of inflammation, and became manifest as lanceolate figures (Spiessfiguren), much as crystals are formed from a solution. His suggestions and criticisms of earlier work met with great and successful opposition from Klemensiewicz, Yamagiva, Orth, Lubarsch, Schnaudigl, and others.

Meanwhile the bacteriological aspects of the subject had been investigated, first by Nassiloff (1870), later by Eberth (1873), Orth, (1873), Leber, (1891), and others. Leber's experiments on mycotic keratitis produced in rabbits by aspergillus were especially productive of results from the morphological standpoint. Finally, Councilman (1899) has thrown much light upon the characters of the wandering cells. He has shown that fifteen minutes after central infection of the cornea with staphylococci granular leucocytes are found in the conjunctiva; these are also first to appear in the cornea, and form the majority of the wandering cells. In eighteen to twenty-four hours isolated non-granular leucocytes are found in the peripheral part, and in four days, lymphocytes. The latter occur only in the lymph-channels at the periphery, and probably come from lymphatic glands, and not from the blood. After five days plasma-cells appear in the outer third of the cornea. These and the lymphocytes show mitotic figures, which are absent in the other wandering cells."—(Parsons.)

The cornea derives its nourishment by exudation from a series of minute loops of blood vessels which form a narrow peripheral zone, normally, ½ to 1 mm. wide at the sides and from 1 to 2 mm. at the upper and lower corneal borders. The corneal tissues contain a series of canals and spaces through which nutrition is provided. The freely anastomosing stellate spaces of the lamellæ are known as *v. Recklinghausen's canals* and the tubular passages, running at right angles to one another in the several layers of the stroma and terminating at the sclerotic, are called *Bowman's corneal tubes.* Hamburger (*Klin. Mon. f. Augenh.,* p. 106, Sept., 1913) by obtaining selective staining of the endothelial cells of Descemet's membrane by intravenous injections (*intra vitam*), of methylene blue and indigo sodium sulphate, in rabbits, believes, from these experiments, that the cornea receives some nutrition from the aqueous. Schnaudigel (Graefe's *Arch. f. Ophthal.,* Vol. 86, p. 93) experimenting along similar lines with intravenous injections of trypan blue in rabbits, produced a slight staining of the cornea—the corneal corpuscles at the limbus showing a faint staining. Employing lithium carmin. trypan—pyrrol and isamin blue, Rados (*Klin. Mon. Augenh.,* Vol. 52, p. 421) in like experiments, failed to observe any corneal staining.

Throughout the substantia propria are found corneal corpuscles (Virchow) or fixed corneal cells (Cohnheim), which are really highly differentiated connective tissue cells, and a few small wandering cells of varying shapes—the latter being derived from the limbic blood vessels. Bowman's membrane consists of fine connective tissue fibers and is, as shown embryologically, merely a part of the substantia propria. Descemet's membrane is a homogeneous, elastic lamina derived from the (rearmost) endothelial layer. The endothelial layer is composed of a single layer of cells, continuous with the covering of the iris.

All varieties of keratitis are accompanied by a circumscribed or diffuse infiltration, Bowman (1849) being the first to direct attention to this fact. The exudate is the result of an increase of cellular elements within the corneal stroma. The ordinary connective tissue cells are replaced by fixed and wandering corneal corpuscles. These formative cell-elements migrate from the newly-formed blood vessels springing from the corneal limbus (Virchow (1843) being the earliest investigator to determine this), or they originate by an increase in the number of fixed corneal cells. Sometimes, in cases of acute infection, fine, gray, radial stripes, with straight branches, can be observed with the corneal loupe. "The leucocytes are derived from two sources: (1) Those normally present in the cornea, reinforced during inflammation by others which have emigrated from the peripheral vessels; (2) Those which have made their way in from the conjunctival sac." (Parsons). At the site of the molested area there is an elevation of the epithelial layer during the activity of the infiltrating process, and consequent loss of normal transparency, corresponding to the implicated portion. The structure of the cornea is such that the onset of inflammatory processes is inhibited by the two limiting membranes; the *anterior* (Bowman's) and the *posterior* (Descemet's), both of which act as barriers to the entrance of bacteria and cellular exudates. With the probable exception of the gonococcus and Klebs-Loeffler bacillus, ectogenous microörganisms are unable to gain entrance to the substantia propria unless there is an abrasion of the epithelial layer and probably of the anterior limiting membrane as well, or to reach the deeper structures of the eye, when the cornea becomes infected, by the protection afforded by the posterior limiting membrane. However, neither of these limiting membranes is impervious to some toxins, for instance, those produced by pneumococcal infection, which are able to pass through the corneal structures and enter the anterior chamber, where their presence excites an exudation of polymorphonuclear leucocytes. These cells, being prevented from entering the cornea by the

posterior limiting membrane, gravitate to the bottom of the anterior chamber, giving rise to a condition clinically known as *hypopyon.*

Microbic corneal infection has its origin from three sources: (1) from without (*ectogenous*); (2) by spreading from contiguous tissues, the conjunctiva or ciliary body (*extension*); (3) through the blood stream (*endogenous*). In many cases it is impossible to ascertain the source of the bacterial invasion.

As the cornea is an avascular tissue, protective bodies and cells, in inflammatory conditions, are derived from the blood vessels of the limbus, when the superficial layers (early stages) are affected, and from those of the ciliary body when a morbid process involves the deeper corneal layers. Exudation of polymorphonuclear leucocytes appear at the corneal limbus shortly after injury, but lymphocytes not earlier than the fourth day.

Cellular attraction toward the inflammatory site is seen as a circular gray zone of exudate and when it closely approaches the involved area, is clinically known as *positive chemotaxis;* when an area of clear tissue is interposed between the exudate and the seat of inflammatory process, it is termed *negative chemotaxis.* The latter condition is explained by the paralyzing action of aggressinogen upon the cells, retarding their closer approach.

The course of an inflammatory process of the cornea may be clinically studied in the following stages: (1) infiltration; (2) regressive; (3) progressive; (4) suppuration; (5) cicatricial. The first is characterized by an increase in the number of cells in the substantia propria, the exudate being clinically observed as a haziness at the site of the inflammatory process, above which the epithelial layer is frequently raised and lustreless. This stage may terminate in resorption or progress until the stage of suppuration occurs. (2) The *regressive stage* is represented by one in which there is no actual destruction of corneal tissue, the exudate gradually disappearing by the process of absorption in favorable cases, without leaving a trace of the lesion. Repair is first evidenced by the development of new-formed blood vessels, springing from the limbus, at a point nearer to, and approaching, the affected area. When the focus is central, the reparative vessels develop from all parts of the periphery. These vessels are situated in the most superficial corneal layers; that is, between Bowman's membrane and the epithelium, except in severe or chronic inflammation, when they are found beneath Bowman's membrane. This is a valuable clinical guide in determining the advent of the regressive stage in inflammatory condition of the cornea; (3) In others, the area of infiltration increases in area and depth, there is sufficient

alteration in the structure of the substantia propria, without loss of substance, to produce a permanent opacity of varying size and density. These are the so-called *non-suppurative keratitides;* (4) The *suppurative stage* occurs when the resistive powers of the corneal tissues are no longer sufficient to combat the invasion of the tissues by bacteria or to overcome them when present, and there occurs, at the site of the lesion, a loss of substance and suppuration intervenes, completing a clinical image known as *suppurative keratitis.* The loss of substance first takes place in the superficial layers of the cornea, indicated by a depression (ulcer) of the corneal surface at the site of the disintegration. Only such portions of the cornea as have retained sufficient vitality to resist the progressive processes escape destruction. Destruction of tissue is characteristic of all varieties of *suppuration keratitis,* and its extent is naturally dependent upon the amount of necrosis.

Cicatrization is recognized by a disappearance of the cloudiness and a regeneration of smooth and transparent epithelium covering the edges at first, and later the base of the depression formed by the substance loss, followed by a filling in of the resultant depression by new-formed connective tissues, cellular at first but changing to the fibrillary variety subsequently, which is permanently opaque. A slight flattening of the surface occurs. "Karyokinesis occurs, first, a short distance around the wound and, later, in still more peripheral parts (Neese)." Bowman's membrane is never regenerated, being replaced by epithelium.

Surrounding an ulcer, there is more or less infiltration, but the exudate and cloudiness are moderate in comparison with the older and greater destructive process at the central portion. These peripheral areas, as well, frequently disintegrate and share in the ulcerative process, which characterizes the disease as a progressive corneal ulceration. By the instillation of fluorescein into the eye, an adequate estimate of the affected portions of the anterior corneal layers is clearly outlined.

The development of new blood vessels within the corneal tissue, during the regressive stage, is indicative of cleansing of the ulcerative process and vascularization of the ulcer base is observed. It is important to determine whether newly formed blood vessels are superficial or deep. In large cicatrices, the vessels never entirely disappear. Hypopyon is commonly associated with suppurative keratitis, and is, as above stated, the result of fluids containing toxins, passing through the corneal tissues and exciting, in the anterior chamber, an exudation of polymorphonuclear leukocytes.

A frequent cause of ectogenous infection of the cornea is dacryocys-

titis and the condition of the lacrimal sac should always be determined. There must be a wound of the corneal epithelium, or even Bowman's membrane (which permits the invasion of microöganisms) to produce corneal infection; yet it is maintained by most authorities that infection may occur without abrasion if subjected to long contact with discharges impregnated with gonococci or the bacillus of Klebs-Loeffler.

Varieties of keratitis (all of which are described under their appropriate and separate headings in this *Encyclopedia*) are:

- A. Superficial
  - Pannus
  - Keratitis fascicularis
  - Keratitis marginalis
  - Keratitis punctata
  - Ulcus rodens (Mooren's)
  - Herpes fibrilis corneæ
    - Dendritica
    - Zoster
    - Vesiculosa (et bullosa)
- B. Deep
  - Non-suppurative
    - Sclerosing keratitis
    - Keratitis profunda
    - Keratitis parenchymatosa
    - Keratitis originating posteriorly to the corneal stroma
  - Suppurative
    - Ulcers of the cornea
    - Ulceus serpens
    - Keratitis e lagophthalmo
    - Keratomalacia
    - Keratitis neuroparalytica (severe type).

—(J. D. L.)

The nomenclature of keratitis is much in need of revision, its terminology being especially confused and inconsistent. Thus, the words *striate, reticular,* and *panel-shaped* are often used as synonyms and the terms ''keratitis'' and ''corneal ulcer.'' However, the Editor has endeavored to preserve the identity of the various forms of keratitis in the following headings.

Keratitis, Actinomycotic. See p. 3334, Vol. V, of this *Encyclopedia.* To the statements there found it may be added that three cases of actinomycosis of the cornea are reported by A. Löwenstein (*Klin. Monatsbl. f. Augenheilk.*, p. 859, June, 1914.) They developed after injuries of the corneæ in three men, working in the same coal mine, from pieces of coal. Non-operative treatment, continued for from

three to ten weeks, was of no avail, until cauterization arrested the progress of the affection. Cultures and inoculations of rabbits with clear cultures showed actinomyces.

Keratitis a frigore. (L.) Keratitis due to exposure to cold.

Keratitis amenorrhoica. (L.) (Obs.) A form of phlyctenular keratitis in some women who have amenorrhea or in whom the flow is retarded or irregular.

Keratitis anaphylactica. A name given by Wessely and von Szily to the keratitis due to anaphylactic influences. See p. 339, Vol. I, and **Allergy**, p. 340, Vol. I of this *Encyclopedia.*

Keratitis anesthetica. The term applied by Jakob Stern (*Klin. Mon. f. Augenheilk.,* May, 1908) to a corneal condition resulting from trigeminus anesthesia, after a form of phlyctenular disease. Numerous grey dots appeared either in or immediately under the corneal epithelium, the surface of which remained unaffected. These dots stained with fluorescein, and disappeared or increased in number during observation. Although resembling the effects produced by drying of the corneal epithelium, they bore no relation to this, and were produced in exactly the same manner when the epithelium was covered by an occluding bandage. The cornea had lost its sensibility, but the place of exit of each supra-orbital nerve was extremely sensitive to pressure. The intra-ocular tension was normal. Two months later the cornea had recovered its sensibility and the opacities were no longer observable. During the whole period there was no inflammatory reaction. Stern had met with similar appearances in five other cases, in all of which the sensibility of the cornea was diminished. He ascribes the phenomenon to the defective condition of the surface epithelium permitting the entrance of fluid, and this defective condition to interference with nutrition caused by the state of the fifth nerve. He suggests that this observation may throw some light on the occurrence of neuroparalytic keratitis. See, also, **Keratitis neuroparalytica.**

Keratitis, Annular. See **ring ulcer of the cornea,** p. 3440, Vol. V, of this *Encyclopedia.*

Keratitis, Arborescens. See **Keratitis dendritica.**

Keratitis, Aspergillus. Aspergillar keratitis. See **Keratomycosis**; as well p. 3335, Vol. V, of this *Encyclopedia.*

Keratitis, Atypical. For lack of a better name Morax (*Ann. d'Oculistique,* Oct., 1912) records a curious, infective, corneal lesion which could not be identified with any recognized ocular affection. Although the patient was under observation for eight months, the author was unable by clinical or laboratory methods to determine the etiology of

the singular infection, which, however, presented great analogies with certain forms of experimental corneal mycosis.

The patient, an agricultural laborer, aged 18, had a superficial injury to his right cornea with a piece of straw, which remained in the eye for a week. This was followed by a persistent irritability associated with (1) a small corneal ulcer, (2) the development of iridic nodules resembling syphilitic or tuberculous gummata. The case ran a slow course in spite of varied treatment—atropine, iodoform, cauterization, paracentesis (three times), iridectomy, potassium iodide in large doses, and salvarsan (three intravenous injections of 30 centigrammes). Eventually, the inflammation subsided, leaving leucomata, an occluded pupil, and atrophic patches on the iris. An optical iridectomy was performed with satisfactory result. Bacteriological examination of (1) scrapings from the ulcer, (2) aqueous humor, both pure and after puncturing one of the gummata with the point of a keratome, and (3) the piece of iris excised, gave negative results both in smears and cultures on a varied selection of media. Inoculations of a guinea pig with the excised piece of iris tissue also gave a negative result. The Wassermann reaction was negative, and a subcutaneous injection of a tenth of a milligramme of tuberculin (Institut Pasteur) did not cause any definite reaction.

Three months after the commencement of the inflammation in the right eye, and before the lesions in it were cauterized, the left eye developed definite cyclitis with large precipitates on the posterior surface of the cornea, and moderate inflammatory reaction but no diminished tension or involvement of the deep tissues or vitreous. After several relapses, the cyclitic lesions became milder, but when the patient left the hospital, he still had numerous precipitates on his cornea.

Discussing the possible cause of the peculiar inflammation in his patient's right eye, the author points out that the lesions in it are very similar to those produced by Fava in the eyes of rabbits by the injection of cultures of Sporotrichum beurmanni, but owing to his failure to cultivate the organism, and the inefficiency of large doses of potassium iodide, he rejects the diagnosis of sporotrichosis. The negative results of the tuberculin injection, and the inoculation of a piece of iris tissue in a guinea pig, are against a tuberculous origin, while the negative Wassermann and the absence of improvement after injections of salvarsan, exclude syphilis. The author therefore concludes that it was due to one of the numerous infections of the nature of which we are still ignorant. He is of opinion that the cyclitis in the left eye was probably due to a special form of sympathetic inflam-

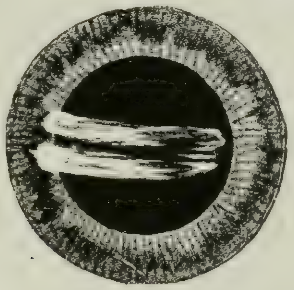
mation, to which the name of "para-sympathetic ophthalmia" should be given temporarily.—(Abstract by Coulter in *Ophthalmoscope*, p. 96, Feb., 1915.)

Keratitis avasculosa. See **Cornea, Dystrophy of the,** on p. 3356, Vol. V, of this *Encyclopedia.*

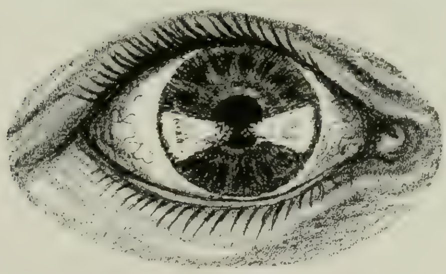
Keratitis bandeletta. KERATITIS EN BANDELETTES. BANDFÖRMIGE KERATITIS. Synonyms of *band-shaped keratitis.* See p. 877, Vol. II, of this *Encyclopedia.*

Keratitis Bandförmige. (G.) See **Band-shaped keratitis.**

Keratitis, Band-shaped. BAND KERATITIS. TRANSVERSE CORNEAL FILM.



Band-like Keratitis. (Würdemann.)



A Variety of Band-like Keratitis. (Würdemann.)

See **Band-shaped keratitis,** p. 877, Vol. II, of this *Encyclopedia;* as well as the illustrative figures in this section.

Keratitis, Bombay. The name given by Herbert to a form of superficial punctate keratitis prevalent in Bombay during the hot, rainy season. Its cause is presumed to be an encapsulated bacillus, not capable of cultivation on ordinary media, that is found in the anterior epithelium of the cornea. See **Keratitis, Superficial punctate.**

Keratitis, Bullous. KERATITIS BULLOSA. See p. 3050, Vol. IV, of this *Encyclopedia;* as well as **Bullæ of the cornea**; and **Cornea, Pemphigus of the**; also **Cornea, Febrile herpes of the.** To this information may

be added here that Gilbert (*Ophthalmic Year-Book*, p. 151, 1909) has been able to compare the anatomical with the clinical findings in six cases of this disease. He agrees with earlier observers in regarding the first stage as a saturation of the epithelium with edematous fluid, but he found that even in the advanced stages there was no intercellular, but rather an intracellular accumulation. A sort of ballooning of the cells goes on, until the protoplasm appears homogeneous, and the nucleus disappears. Eventually the cell-wall breaks, and the contents work toward the surface. This, occurring in the case of a number of contiguous cells, results in the formation of spaces, in which only fluid and cell-detritus is to be found. The basal cells seem to be especially prone to this change. Where all the basal cells had disappeared the superficial remained, like a bow, over the accumulated fluid. He thinks it is not a simple lifting up of the epithelium, but the bleb formation is accomplished only at the expense of the basal cells. The fluid present gives the mucin reaction. The fluid is not secreted in the cell body, as is the function of certain epithelial cells, but rather the whole cell undergoes a mucous degeneration. Some hyaline degeneration was also noticed.

But the pathological process does not end here. In the later stages there appear blood-vessels between the old and the new-formed epithelial cells. These vessels come from the limbus, and are not accompanied by fibrous tissue. It is therefore a degenerative process and not a true keratitis. He found pannus microscopically, when clinically it was invisible. Primarily *pannus degenerativus* is to be found exclusively between Bowman's membrane and the epithelial layer. It may later invade the anterior lamellæ. Fibrous or sclerotic changes also occur. Pannus degenerativus, according to Gilbert, is to be regarded as the anatomical cure of bullous keratitis. Where the subepithelial pannus is observed there is no bulla formation, and conversely when bulla formation occurs little or no pannus is to be seen. Blood vessels can be seen sprouting into the cavity of the bulla. These probably organize and consolidate the cavity.

Keratitis, Caisson. See **Caisson disease,** p. 1354, Vol. II, of this *Encyclopedia;* also page 454 of the *Enkyclopedie der Augenheilkunde.*

Keratitis, Calcareous. See p. 1355, Vol. II, of this *Encyclopedia;* as well as **Cornea, Calcareous degeneration of the**; and **Cornea, Lime incrustations of the.**

Keratitis, Central annular. The name given by Vossius to a variety of interstitial keratitis that begins with a dense macular deposit in the central, pupillary area of the cornea. Sometimes several smaller maculæ form, combine and remain as a permanent opacity. Still

more rarely the opacity occupies the lowest part of the cornea, when it may assume a triangular shape. See, also, **Keratitis parenchymatous,** at the first third of the heading.

Keratitis, Central parenchymatous. See **Keratitis, Central annular**; and **Keratitis profunda.**

Keratitis, Chicken-pox. See **Keratitis, Varicella.**

Keratitis, Circumscribed. See **Keratitis profunda.**

Keratitis, Cocain. An example of this form of corneal damage from the improper use of cocain has been reported by Jackson (*Ophthalmic Year-Book,* p. 148, 1910). There were large, crescentic ulcers at the upper corneal margin together with conjunctival hyperemia and dermatitis. Cocain had been used for ten weeks. On the third day after treatment of the toxic keratitis with nitrate of silver and holocain the ulcers no longer stained. See, also, **Keratitis, Toxic.**

Keratitis, Congenital. See pp. 3340 and 3341, Vol. V, of this *Encyclopedia.*

Keratitis, Deep. See **Keratitis profunda.**

Keratitis, Deep marginal. See **Keratitis, Marginal, Deep.**

Keratitis, Deep punctate. See **Keratitis punctata profunda.**

Keratitis, Deep suppurative. See **Keratitis, Suppurative**; as well as **Cornea, Serpent ulcer of the,** on p. 3447, Vol. V, of this *Encyclopedia.*

Keratitis, Deep ulcerative. See **Cornea, Serpent ulcer of the.**

Keratitis, Deep vascular. See **Keratitis, Vascular, Deep.**

Keratitis dendritica. MALARIAL KERATITIS. STELLATE KERATITIS. DENDRIFORM ULCER OF THE CORNEA. KERATITIS ARBORESCENS. FURROW KERATITIS. Horner, in 1871, described a vesicular keratitis associated with herpes facialis (see under **Cornea, Herpes of the**), occurring in individuals suffering from a number of general diseases. It is probable that this corneal inflammation is one and the same as that included in the title synonyms. Kipp, in 1880, was the first to direct attention to the now well recognized etiology of this variety of keratitis, viz., malaria, which he found present at the time of the appearance of the corneal inflammation, or which had existed prior to the attack. Kendall and Godo, also in 1880, described the same disease; Godo found malaria present in one-third of his cases. Hansen-Grut (1884) in an article on this disease, assigned to it the name of dendritic keratitis. Later, Emmert described a corneal disease, probably identical, and gave it the name *keratitis exulcerans dendritica mycotica.* In addition to the above contributions, articles on the same subject, by the following writers, have appeared in American literature: Kipp (1890), Wilder (1893), Ellett (1899-1915), and Charles (1904-1907).

Dendritic keratitis is characterized by spreading, superficial linear

lesions, having branchings similar to a tree, which usually terminate in nodular swellings. The grayish borders of the circumscribed furrows may be sloping or perpendicular. The adjacent areas are infiltrated in the form of discrete or confluent nebulous opacifications. The disease usually makes its appearance near the periphery of the cornea, from which point the serpentiform ramifications extend in various directions; sometimes, according to Kipp, crossing the entire cornea. The arborescent configurations usually stain readily with fluorescein and, again, the whole cornea is discolored (Verhoeff) or, as pointed out by Ellett, the lesions do not stain at all. The process, as a rule, does not invade Bowman's membrane, for which reason the opacity remaining at the site of the lesion is faint and unaccompanied by vascularization.

The irritative symptoms—photophobia, epiphora, ciliary injection and pain—are present in variable degrees, except in the torpid variety, when they are absent. Kipp speaks of pronounced supraorbital neuralgia as one of the subjective symptoms.

Ellett (*Ophthalmic Record*, Vol. 8, No. 3, March, 1889), in whose community malaria is a prevalent disease, has been afforded exceptional opportunities to ascertain the cause of this disease, which, he believes, is almost entirely dependent on malarial infection, a claim Ellett has frequently verified by blood examinations. His view concurs with Kipp, that the disease may properly be considered as *malarial keratitis*. This observer is inclined to believe that the eruption is always primarily papular and not vesicular, as held by others. With reference to the blood findings, Ellett says that "as regards the form of malarial organisms found in the blood of these cases I have said that the intermittent (tertian or quartan) are most common. The estivo-autumnal also occurs, all indeed, except the crescents, which I am informed are not found in the blood of patients who contract malaria in the vicinity of Memphis. Another curious fact of which there is no good explanation."

Charles (*Ophthalmology*, Vol. 3, No. 4, July, 1907) divides the disease into two classes; the herpetic, a form which is characterized by the presence of vesicles; and the papular, with attendant signs and symptoms of malaria so frequent as to be considered malarial. In either variety, if the vesicles or papules do not immediately disappear, they break down and become dendriform ulcers. Charles believes the disease is due to a terminal nerve lesion, basing his theory upon the following observations: The corneal condition is the result of diseases that attack the central or peripheral nervous system; the path of the arborescent lesions suggests the tract of a nerve branch; the corneal

lesions are above Bowman's membrane where the finest branching nerve fibrils lie, and corneal anesthesia, in many cases, may be accounted for by the action of toxin upon the nerve terminals.

Emmert, Rosenhauch, Keiper and Spencer have been able to recover bacteria from the furrow scrapings, but similar attempts by other investigators have been unsuccessful, leading them to the conclusion that an ectogenous bacterial causative factor is untenable. The view of Uhthoff and Axenfeld, that the presence of organisms in the furrow débris is the result of contamination, and not the primary cause, is probably correct. They examined a group of seven cases; in two, they found the xerosis bacillus alone; in two others, associated with staphylococci; the findings in the remaining cases were negative.

Treatment. Constitutional therapy for the underlying cause, malaria, in nearly every instance, calls for the administration of quinine. The specific action of this drug affords convincing evidence of the malarial origin of the disease and the endogenous paludic poisoning. In addition to quinine, Ellett advises a tonic with Fowler's solution. Locally, Nuel recommends the application of methyl-blue crayon to the margins; Darier, scarlet red ointment; Knapp, painting with a soluble salt of quinine, yellow oxid of mercury and a protective shade, and in the sluggish forms, recommends penciling with carbolic acid or, preferably, nitrate of silver. Holocain is a valuable remedial agent in this disease. In cases in which the ulcer becomes infected or shows tendencies to extensive spreading, the actual cautery may be employed.

Galvano-cauterization, while it is productive of beneficial results, is contraindicated when the lesion is near the pupillary area, owing to the dense scars following its use. Lewis has found careful applications of a 10 per cent solution of trichloracetic acid a satisfactory substitute for the cautery.—(J. D. L.) See, also, **Keratitis mycotic**; as well as p. 3347, Vol. V, of this *Encyclopedia.*

Keratitis, Dendritica exulcerans mycotica. A name given by Emmert to a form of dendritic keratitis. See p. 3347, Vol. V, of this *Encyclopedia;* as well as **Keratitis dendritica.**

Keratitis, Dental. PYORRHEAL KERATITIS. Lesions of the cornea, including ulcer and keratitis, are in some (probably rare) instances due to indirect poisoning from diseased teeth. This subject has been discussed not only under **Keratitis** but, to some extent, under **Focal diseases** and **Dental amblyopia**; particularly on p. 3822, Vol. V, of this *Encyclopedia.* The reader is referred, for a full statement of the argument favoring the occasional association of keratitis with dental caries to the article of Henry W. Blum (*Ophthalmic Record,* p. 389, August, 1916).

Keratitis, Desiccation. See **Keratitis e lagophthalmo**; and **Keratitis neuroparalytica.**

Keratitis, Diabetic. A form of the disease supposed to result from a predisposition excited by glycosuria, or by glucose products in the blood and lymph supply of the cornea. In two cases of diabetes Gallus (*Klin. Monatsbl. f. Augenh.*, p. 499, April, 1910) observed a peculiar form of keratitis characterized by diffuse infiltration with moderate inflammatory reaction and slight vessel formation. There was no disturbance of sensation and no increase of intra-ocular tension.

Keratitis, Diffuse. See **Keratitis parenchymatous.**

Keratitis, Diplobacillary. DIPLOBACILLUS ULCER OF THE CORNEA. See p. 3350, Vol. V, of this *Encyclopedia.*

Keratitis, Disciform. DISC-LIKE KERATITIS. In addition to the definition of this term on p. 4022, Vol. VI, of this *Encyclopedia,* one may add

Keratitis Disciformis. (Posey.)

here that in this rare form of keratitis, originally described by Fuchs (1901), a delicate discoid opacity develops in the middle and deep layers of the cornea. It is allied to ulcus serpens, but is a disease of less intensity. The surface of the cornea, corresponding to the affected area, is dull and insensitive. The disease is one which persists from one to several months and usually attacks persons of middle life. Fuchs describes the clinical picture as follows: "In the center of the disc a small, more deeply clouded speck is commonly observed. The periphery of the disc is sharply delimited by a border of deeper gray, which in many cases is made up of concentric lines." The "riders" radiating from the more deeply infiltrated central spot, through the halo of infiltration, toward the periphery, are, according to Fuchs, caused by crinkling of Descemet's membrane.

Only in rare instances is there any loss of corneal substance, and when it occurs, is always circumscribed and the result of small ulcers. Permanent opacity always remains following keratitis disciformis. In some cases the irritative symptoms are slight; in others, congestive

symptoms are pronounced, superficial and deep vessels developing, which penetrate the cornea in a direction toward the infiltrated area. Slight hypopyon and, occasionally, uveitis, complicate the disease.

According to Erdmann, increased tension is quite commonly present and he remarks that the albuminous contents of the aqueous humor is worthy of consideration.

Etiology. Injury to the epithelium, corresponding to the highly infiltrated central spot, which permits of infection, is generally considered as the usual cause of this type of keratitis. It has been observed following herpes corneæ febrilis. Aside from these factors, the etiology is obscure.

Landmann's (*Archiv. of Ophthalm.,* Vol. 36, May, 1907) detailed report of two cases closely corresponds to the description of this affection as set forth by Fuchs. In one case there was no irritation; in the other, the symptoms were pronounced. Landmann regards the disease as one of inflammatory infiltration.

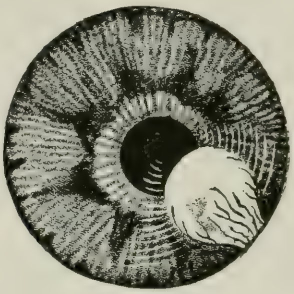
Zentmayer (*Ophthalmology,* Vol. IV, No. 1, p. 26, Oct., 1907) has described two cases (one following a variolous ulcer and the other herpes of the cornea) presenting early clinical features so atypical as to render the diagnosis doubtful until the resulting opacity had appeared.

Schirmer's (*Archiv f. Ophthalm.,* Vol. LIX, p. 133) observations were made on human eyes, accidentally infected with vaccine virus. Virus taken from these foci was used to inoculate the eyes of animals, with the result that he was able to associate keratitis disciformis with the corneal lesions in the vaccinated cases. Following the inoculations, a small, superficial disc-like hazy area appeared shortly afterward, the central portion of the opacity being most pronounced and the outer or less densely infiltrated area terminated with sharply defined margins. As the superficial changes decreased, radiating lines appeared in the deeper layers of the cornea. The area was also occupied by a number of circles, arranged concentric to the disc.

Contrary to the usual descriptions as to the location of the opacity, Posey (*Ophthalmology,* Vol. II, No. 3, p. 434, April, 1906) found, in two cases, the position of the opacities to be quite superficial. Inspection of the injured eye in one case, occurring in a stone-cutter, thirty-four years of age, who had been struck in the right eye by a stone one month previously, revealed a grayish-white opacity superficially situated in the pupillary area of the cornea. It was of disc-like form, and with sharply-defined edges. The rest of the cornea was clear with the exception of a few dots and lines, which also seemed to be superficial and were most abundant in the lower quadrant of the cornea.

The eye was quiet, and there were no traces of recent or old blood vessels upon it. The fundus was normal. When studied with the Zeiss corneal microscope, the opacity was found to be composed of a series of small, rounded elevations, resembling minute blisters. Its edges were sharply-defined, and with the center, were denser than the rest of the opacity. The symmetrical disc-like form of the opacity was broken at its temporal border, for at this point there was a broad prolongation jutting several mm. from it, whose edges were well defined and limited from the surrounding tissue.

Meller (*Klin. Monatsbl. f. Augenheilk.*, p. 335, October, 1905) has reported his histologic findings in an eye which, clinically, was apparently a case of diffuse parenchymatous keratitis, the central and deeper



Disc-like Keratitis. (Würdemann.)

layers of the cornea showing a disc-like opacity. A small ulcer developed in the center of the cornea. The eye was enucleated owing to the development of irido-cyclitis and a complicating secondary glaucoma. He found the epithelium elevated and thickened, and infiltrated with free, round cells. Bowman's membrane was normal. In Descemet's membrane, numerous folds were present, and on its posterior surface there was a thick fibrinous exudate, disc-like in shape. Between both limiting membranes the substantia propria exhibited the presence of infiltration. This author believes the morbid condition may be explained by the rapid arrest of its early spreading tendencies and that the infiltrating process continues until a total necrosis of the involved area occurs. Meller thinks the inflammatory infiltration is probably due to infection, although the bacteriologic examination was negative.

Peters (Graefe's *Archiv f. Ophthalm.*, Vol. LVII, p. 93) rejects the theory of several other observers who believe this type of keratitis is the result of a primary necrosis of the parenchyma. He attributes the affection to a necrobiosis of the tissues—the true nature of which is not fully understood—resulting, most probably, from a disturbed

innervation and, consequently, an impairment of nutrition. This author holds that injury to the endothelial layer, induced by the edema resulting from trauma, is responsible for the opacity; infection or an abscess being responsible for the disc only in exceptional cases.

Hadano (*Zeitsch. f. Augenh.*, Vol. X, No. 6, p. 500) has microscopically confirmed the clinical views of Peters. A study of the disc revealed no signs of inflammatory infiltration; only a few nuclei were found in the periphery and none in the central portion. Throughout the quite homonymous mass, loose tissue, arranged in bundles, was interwoven. No micro-organisms were present.

Treatment. Keratitis disciformis is a disease which does not readily respond to treatment. Atropine may be indicated. Hot fomentations and dionin are sometimes followed by beneficial results. Repeated subconjunctival injection of a 2 per cent. saline solution has been suggested.—(J. D. L.)

Keratitis, Dysenteric. A form of corneal disease supposed to result chiefly from the systemic and local conditions induced by severe or chronic dysentery. See p. 4106, Vol. VI, of this *Encyclopedia.*

Keratitis, Dystrophic. See p. 3356, Vol. V, of this *Encyclopedia.*

Keratitis, Eczematous. In addition to the discussion of this subject under **Eczema, Ocular relations of,** it is also considered under **Keratitis, Phlyctenular,** of which eczema of the cornea is occasionally regarded as a variety.

Keratitis e lagophthalmo. KERATITIS FROM DESICCATION. KERATITIS XEROTICA (FEUER). A disease due to inability of the lids to completely close over the eyeball, and, consequently, normal protection to the cornea from the irritating influences of air, wind and dust is no longer provided, nor adequate moisture maintained, owing to the evaporation of the normal secretions. The extent of the corneal involvement, preceding the ulcerative stage, corresponds to the size of the opening of the palpebral aperture produced by the defective mechanical action of the lids.

Conjunctival irritation, especially at that portion corresponding to the palpebral fissure, is another constant clinical event. The tissues of the exposed area become hyperemic and more or less thickened. After a time the unprotected cornea assumes a dull-gray, opaque appearance and later it becomes slightly depressed. Subsequently the cloudiness increases, disintegration of the superficial layers intervenes, and fissures appear, opening avenues for the entrance of microbic infection, and eventuating in ulceration, iritis and hypopyon. If perforation does not occur, the process heals with a permanent, dense

corneal opacification. In event of perforation, the iris becomes prolapsed or panophthalmitis destroys the eye.

Etiology. Lagophthalmos itself results from one or more of the following etiological factors, some of which are largely mechanical, such as congenital defects, burns, ulcerations, injuries, ectropion from paralysis of the orbicularis palpebrarum resulting from facial palsy, contraction of Müller's muscle, long-continued illness, and proptopsis resulting from exophthalmic goiter or exophthalmos.

When lagophthalmos is well marked, complete closure of the palpebral fissure is not possible, except by extreme effort, and, therefore, certain portions of the cornea are exposed during sleep, when the reflexes are absent and the cornea becomes more or less dry. If this condition remains unaltered for any length of time, desiccation of the corneal epithelium occurs, and it becomes fissured and desquamates, not over its whole surface, but on the exposed circumscribed areas. In exaggerated forms, or in cases of extensive symblepharon, the central portion, or even the superior half of the cornea may become involved.

It is essential to the development of the eyelids, that is to say, to attain their normal length, that the margins of the lids, during fetal life, be adherent for a considerable length of time. When there is a failure of this union, from whatever cause, the condition of microblepharon is frequently the result, and lagophthalmos is thereby produced. As a result of inadequate moisture, keratinization occurs under the desiccating influence of the atmosphere, the exposed portion of the cornea develops epidermoid characters and the epithelium assumes a papillary condition in appearance. In severe cases, especially of anterior staphyloma, the condition of hyperkeratosis (hornlike structure) appears, a condition occasioned by failure of the dried cells to be cast off and they remain adherent to the corneal lesion. Ulceration of the cornea is a quite common sequence to this condition and keratomalacia occasionally develops.

If desiccation of the cornea is not arrested, the *prognosis* is always unfavorable.

Treatment. The first essential requisite is to afford the cornea protection by whatever means seems most effective. This may be accomplished by bandaging or closing the palpebral fissure with plasters at night (and a part of the day as well, in severe cases), or stitching the lids together, to prevent desiccation. In some cases it is possible to correct the mechanical obstacles by surgical intervention, as in symblepharon.—(J. D. L.) See, also, **Ganglion, Gasse-**

rian (p. 5342, Vol. VII, of this *Encyclopedia*) ; as well as **Keratitis neuroparalytica**; and **Lagophthalmos.**

Keratitis en Bandelettes. See p. 877, Vol. II of this *Encyclopedia.*

Keratitis, Endogenous. A corneal inflammation of metastatic or systemic origin. See, e. g., p. 3362, Vol. V, of this *Encyclopedia.*

Keratitis, Erosion. Recurrent or relapsing keratitis. See p. 3438, and p. 3364, Vol. V, of this *Encyclopedia.* Attention is also drawn to the essay by Philip A. Harry (*The Lancet,* p. 1679, June 13, 1914) who gives a complete account of this annoying, stubborn and often serious disease. He calls the condition *traumatic exfoliative keratitis.* A still earlier article by J. A. Menzies (*Ophthal. Review,* XXI, Dec., 1902) refers to the disease under the title, "Detachment of the Corneal Epithelium."

Keratitis, Erysipelatous. Waldstein has reported under the title *erysipelas of the cornea* a case in which there was corneal opacity with the formation of small blebs or vesicles in the central area, with moderate conjunctival injection, photophobia and lacrimation, and with typical erysipelas of the lids and brow. The corneal changes advanced and receded with the skin lesion. Streptococci were obtained in pure culture from the corneal lesions. The recovery was rapid and satisfactory. See, also, p. 4510, Vol. VI, of this *Encyclopedia.*

Keratitis, Exposure. See **Keratitis, Neuroparalytic.**

Keratitis, Fädchen. Filamentous keratitis.

Keratitis, Family. See **Keratitis, Nodular**; also p. 3410, Vol. V, of this *Encyclopedia.*

Keratitis, Farmer's. See **Keratitis, Reaper's.**

Keratitis, Fascicular. This condition is mostly seen in phlyctenular ulcer (see **Keratitis, Phlyctenular**) when the nutrient vessels, that extend from the sclerocorneal margin to the ulcerating area, form a leash or band (fascicle) and thus give the name to the disease.

Keratitis, Fetal. Fœtal keratitis. Congenital keratitis. See p. 3340, Vol. V, of this *Encyclopedia.*

Keratitis, Filamentous. Filamentary keratitis. Filiform keratitis. Fadchenkeratitis. This rare and peculiar disease of the cornea was first described by Leber in 1882. It is restricted to the epithelial layer, and, therefore, develops only in superficial affections of the cornea. The inception is characterized by a slight elevation of the epithelium and the formation of small vesicles on the cornea. The vesicles are of short duration, as they quickly rupture and are replaced by small, shallow ulcers. The filaments springing from the corneal lesions are, at first, very short and may escape observation; hence the condition

may be confounded with herpes, as the clinical resemblance to this disease, on cursory examination, is striking.

The filaments arising from the numerous corneal lesions are quite firmly attached by an expanded base, and, as they stretch, become pedunculated and twisted into a spiral, the distal end, which is frequently bulbous, hanging free upon the cornea.

Leber held that the filaments were of a fibrous nature, brought about by coagulation products derived from the conjunctival sac, which become attached to a corneal abrasion, and grow by accretion. Subsequently, an epithelial formation extends for a certain distance upon the proximal end. Both Uhthoff and Fischer (1882 and 1889) observed the original lesions as vesicular formations upon the cornea and agreed with Leber regarding their fibrous nature. Uhthoff believed the filaments were a continuation of Bowman's membrane. Fischer contended that they were fibrous coagula derived from the secretions of the inflamed cornea, and thought their characteristic shape was caused by the inherent elasticity of the filament.

Filiform Keratitis.

Hess (1892 and 1893) was the first to study the histologic arrangement of the filaments, and Nuel, about the same time, made similar investigations. They conclusively demonstrated that the filaments do not consist of fibrin, but are composed of epithelial cells which become separated from the cornea and assume a torsional form. MacWhinnie (*Ophthalmology*, Vol. V, No. 2, p. 225) concludes, from a study of two cases, that the filaments are the result of the coagulation of the epithelial cells which have not acquired a state of full development, due to impaired nutrition. He believes the nutritional factor accounts for the greater frequency of this disease in Europe, where the nutrition of the peasant is insufficient.

Posey believes the filament may probably contain subepithelial tissue, as well as superficial, and that fibrin, or mucous threads, could become

attached to the corneal filament, having, however, little to do with the origin of the filament.

Filaments, similar to those described, have been observed in connection with corneal ulcers. These disappear when the ulcerative process has terminated.

There is another form of filaments, arising from the site of discission wounds, and in the incision for cataract extraction, which are not attached to the epithelium. Hess has described this particular filament, which he believes to be formed by the vitreous expressed through the opening made by the needle. These filaments, which develop at the site of the puncture, are clear and composed of hyaline and a few leucocytes, without, however, any epithelial cells. There is a central, core-like portion to these filaments. In five cases, Piccaluga observed the development of filaments in the incision for cataract extraction. Assuming, therefrom, that the condition depends upon the presence of fragments of tissue retained in the wound (lens capsule or vitreous), he conducted a number of experiments on rabbits to ascertain if a similar effect would follow the introduction of a foreign substance into the cornea. Small pieces of cotton thread were employed for the purpose. In most cases, a characteristic filament developed, which became detached in from seven to ten days. Microscopic examination showed the central cord clothed with filamentous mucus, consisting of numerous leucocytes, epithelial cells and débris. Piccaluga concludes that atypical forms of filaments may arise from inclusion of some foreign substance between the epithelial margins of a corneal wound, and that the typical variety may result from the retention of a particle of fibrin between the epithelial cells, following the rupture of a vesicle.

The bulbous termination consists, principally, of nuclei sometimes arranged in clusters.

Marshall believes the formation of the filaments depends upon a proliferation and detachment of the corneal epithelium. He points out the striking resemblance between the corneal filaments and the so-called Curschmann's spirals so frequently present in the sputum of patients who suffer from various forms of bronchial catarrh. While of the opinion that the movements of the eyelids may possibly have some effect upon the peculiar shape which the filaments assume, the form of the bronchial spirals is not explained by similar mechanical influences, and Marshall believes the causative factors have not been determined.

MacWhinnie points out that the parasitic organism known as coccidia, present in the center of the epithelial nests, and never found

unless nutritional impairment exists, has, probably, an influence upon the epithelial formations.

The factors responsible for the spiral formation of the filaments have not been definitely determined. The most generally accepted explanation is that the torsion, produced by the movements of the lids, accounts for the formation of the pedicle.

Hess has classified filamentary keratitis, etiologically, as follows: (1) Idiopathic; (2) Arising from superficial trauma; (3) Arising from long-continued applications of hot bichlorid or boric acid compresses.

Parsons believes that idiopathic cases are rare and are generally preceded by vesicles. He attributes the origin of some cases to an antecedent corneal abrasion or wound.

Atypical Filamentary Keratitis. (Würdemann.)

Zentmayer and Goldberg (*Ophthalmology,* Vol. II, No. 3, April, 1906) record, in detail, their clinical and histological findings in a typical case, occurring in a female patient, thirty-five years of age. The disease developed in an amblyopic eye which had converged since childhood. The onset was marked by lacrimation, photophobia, slight pericorneal injection and pain, which became severe in the left side of the head. Later, there were slight febrile symptoms and labial herpes. The gross appearance was one of numerous vesicles and threads covering the upper half of the cornea. Viewed through the loupe, the supposed vesicles proved to be transparent droplets, attached to the cornea by short pedicles, some of which, later, became increased until they were several millimeters in length. Two small epithelial ulcers, which stained with fluorescein, were present in the lower portion of the cornea.

Filamentary keratitis is a disease rarely occurring before the sixty-fifth year. Terson, in opposition to the claims of other observers, asserts that the affection also occurs in the young and, apparently, in

healthy individuals. The influence of various dyscrasias upon the delicate ramifications of the ciliary nerves, may, according to Terson, enter into the etiology of the disease. The irritative symptoms, photophobia, lacrimation, slight pericorneal injection and pain, are strongly suggestive of a neuropathic origin, i. e., a disturbance of the trigeminal nerve and, in some way, a kinship to herpes.

The onset of the disease is sudden, frequently occurring without any history of recent injury, but sometimes an antecedent conjunctivitis exists. The specific cause of the lesions is not attributable to microbic origin.

The exacerbations are frequent, occurring from a few days to several weeks and the condition may continue for months and even years.

Treatment. Most clinicians recommend removing the filaments. Nuel employs a 2 per cent. aqueous solution of ammonium chlorid. Sourdille favors collyria of methyl-blue. Darier employs the galvanocautery to destroy the primary lesion, but when it is located near the border of the cornea, he suggests the sliding conjunctival flap.

Zentmayer treated his case three months with strong iodoform ointment, a 1 per cent. solution of ammonium chlorid and compress bandages, the result being a permanent reproduction of normal epithelium.

Terson has been unable to effect any satisfactory results with antiseptics or caustics. He mentions two cases, one of which was decidedly benefited, and the other completely cured, by free applications of a 1 to 1,000 solution of bichlorid. He advocates the use of repeated subconjunctival injections of sterilized air in cases which prove rebellious.

MacWhinnie recommends mechanical massage and high-tension faradic current, supplemented with high frequency, applied by suitable electrodes, the effect being to increase the blood supply.—(J. D. L.)

Keratitis, Filiform. See **Keratitis, Filamentous.**

Keratitis, Flame-shaped, marginal. See **Flame-shaped marginal epithelial keratitis,** p. 5221, Vol. VII, of this *Encyclopedia.*

Keratitis, Frenular. See **Keratitis, Snail's track.**

Keratitis from acne rosacea. See **Keratitis rosacea.**

Keratitis, Furrow. MALARIAL KERATITIS. See p. 3347, Vol. V, of this *Encyclopedia;* also, **Keratitis dendritica.**

Keratitis, Gitterförmige. (G.) Grill-like keratitis.

Keratitis, Gonorrheal. That the gonococcus is one of the most potent causes of serious ulcer of the cornea is well known. It forms, also, the chief danger in gonorrheal conjunctivitis (see, e. g., p. 3139, Vol. V, of this *Encyclopedia*) and in conjunction with other micro-organisms

induces corneal infections of varying degrees of intensity. Stadfeld attributed to gonorrhea a parenchymatous keratitis, accompanied by a superficial infiltration and conjunctivitis, which he first noticed five weeks after the beginning of the urethral discharge. It healed in three weeks, leaving slight, superficial specks and small, deep-seated blood vessels. Byers has collected from the literature, 30 cases in which keratitis was associated with systemic manifestations of gonorrhea, 9 of which he considers probably metastatic in origin. In two the true corneal substance was clearly affected; in the others the inflammation appears to have been superficial. Axenfeld has suggested that the gonococcus cannot cause abscess in the midst of an avascular tissue like the cornea, because it becomes an irritant as soon as it escapes from the vessels. Byers meets this by pointing out that gonorrheal metastases are caused by the carrying of the gonococcus throughout the body in the leucocytes, and their liberation on the death of the leucocyte. He thinks that it is quite possible for a leucocyte to wander into the cornea and there set free the gonococcus.

Heerfordt (*Ophthalmic Year-Book,* p. 151, 1910) observed in cases suffering from urethritis and joint affections a vesicular corneal eruption, phlyctenular in character, and when deep, scleral nodules were present, and the lesions were herpetiform. One-half of the cases of episcleritis of gonorrheal origin which he reports had corneal complications, these complications being of more frequent occurrence than iritis. Bjerrum, in the discussion of Heerfordt's cases, reported having observed many more cases with iritic than with corneal complications. In a case reported by Van Lint, keratitis suddenly developed in one eye following the subsidence of a gonorrheal conjunctivitis of metastatic origin. Gonococci were not present in the secretion. Bullæ first formed, which later ulcerated but healed in three days. Pericorneal injection was absent but photophobia was intense. Following this attack a metastatic iritis appeared in the other eye. In Posey's case six or eight vesicles developed upon an old macula. They contained the gonococcus. Arthritis was absent. Antigonococcic serum had no appreciable effect upon the process but produced some febrile reaction. He quotes Byers as claiming that the keratitis associated with systemic gonorrhea is typically of a multiple and superficial nature, generally symmetrical in character and central in situation. Some cases, Posey thinks, may be due to the extension of the disease from the surrounding structures, as was probably true in the two cases which he had previously reported, the one being complicated with conjunctivitis, the other with irido-cyclitis. Van Lint has seen a case of metastatic keratitis; and Asher reports one in which there was deep yellowish

infiltration in each cornea, which subsequently cleared, but left vision impaired. See, also, p. 5606, Vol. VII, of this *Encyclopedia.*

Keratitis, Grating-like. See **Keratitis, Grill-like.**

Keratitis, Grill-like. Lattice-shaped opacity of the cornea (Fuchs). Panel-like keratitis. See p. 3382, Vol. V, of this *Encyclopedia;* as well as the figure in this text, also **Cornea, Family degeneration of the.**

Keratitis, Guttate. See p. 3371, Vol. V, of this *Encyclopedia;* as well as **Cornea, Family degeneration of the.**

Keratitis, Harvester's. Reaper's keratitis. Farmer's keratitis. During agricultural operations injuries of the cornea from wheat stalks, barley beards, straw and similar agents are not uncommonly followed by various infections—especially if the subject be suffering from some form of conjunctivitis or dacryocystitis. Calderaro (*Ophthalmic Year-*

Panel-like or Grill-like Keratitis. (Würdemann.)

Book, p. 130, 1913) believes that on the ends of the beards of grain and in the top branches of many trees, known as causative agents in hypopyon keratitis, streptothrix is frequently found during the time of harvest, and in some localities various species of this organism may be met. These micro-organisms occur also in the healthy conjunctivæ of harvesters, and in the conjunctiva of the sound eye of individuals affected in the other eye with the keratitis of harvesters. In one case of keratitis, sixteen hours after the injury by the beard, he isolated a streptothrix, which disappeared and was not found in the successive examinations; after the third day the presence of the pneumococcus alone was demonstrated. Streptothrix, in regard to its virulence in the eyes of animals, may be divided into three groups: First, to which belongs streptothrix albus; this form is the most usually met and behaves as an innocuous saprophyte; second, to which belong a few species of the streptothrix chromogena, that possess moderate virulence for the different parts of the eye; third, including the general streptothrix chromogena and violacea, both of which are capable of producing the

most serious changes in the eye, that end finally in panophthalmitis. Experimental infection of the cornea with streptothrix, virulent or not, is supplemented by infection with the pneumococcus or other pyogenic germs, that are found to have been deposited by experiment in the conjunctiva. The presence of virulent streptothrix in a traumatic corneal lesion produces a propitious soil for infection by pneumococcus and increases its virulence. The tips of the beards that remain in the epithelium and in the corneal parenchyma retard the cure of the smallest wound produced by this means, and prepare a most favorable soil for the development of pyogenic germs; for this reason corneal wounds that are not easily visible, received during the time of harvest, produce hypopyon keratitis. An atypical keratitis, which consisted of an exogenous infection of the cornea associated with gummata of the iris, followed by cyclitis of the fellow eye, was reported by Morax, where a small corneal ulcer appeared after injury by a straw, followed by appearance of iris nodules resembling gummata. Three months later cyclitis with descemetitis occurred in the other eye. Inflammation finally subsided in both eyes, leaving the patient with some impairment of vision due to corneal opacities. Sporotrichosis, tuberculosis and syphilis could be excluded. The writer considered the affection a parasympathetic inflammation induced by hematogenous transference of the infection. Lindner reported a peculiar case of keratomycosis aspergillina which was unusual in that the lesion, instead of exhibiting the usual dry, crumbling appearance of the surface, was smooth and succulent.

The *treatment* of harvester's keratitis does not differ from that of similarly infected wounds.

Keratitis, Herpetic. See p. 3372, Vol. V, of this *Encyclopedia*.

Keratitis, Hypopion. Purulent keratitis. See **Cornea, Serpent ulcer of the,** p. 3447, Vol. V, of this *Encyclopedia.* To the subjects discussed under that heading may be added a brief abstract of the recent work of Speciale-Cirincione (*Clinica Oculistica,* p. 1601, 1914). This author claims that the chief danger of hypopion keratitis is the damage done to the corneal tissues by the secondary infection. Increase of tension, another effect of infection, is constantly present in the first days of the disease. The best remedy against this dangerous disease should be one which isolates the corneal focus from attack by conjunctival secretion, and which further facilitates the intraocular lymphatic circulation and that between the corneal layers. To this end after treating the conjunctiva and, if necessary, the lacrimal passages, the ulcerative focus is electro-cauterized. Then the conjunctiva is divided in the whole circumference of the cornea, and sclero-corneal

trephining is done according to Elliot's method. The conjunctiva is sutured over the cornea in such fashion that the sutures do not touch the cornea, and the raw margins of the conjunctiva are brought together. The result is stated to be that the pain soon ceases and the patient does not require any special care for about ten days, after which the cornea is uncovered. If complaint of pain is made it is a sure sign that the cornea is at some point in direct contact with the conjunctival secretion. If the conjunctival suture is removed too early reinfection may occur, and if it is left too long the conjunctiva may adhere solidly to the cornea. Any adhesion of the conjunctiva to the cornea at the end of the ten days is friable, and the former will retire to the limbus within forty-eight hours after removing the suture.

Keratitis, Inherited. See **Keratitis parenchymatous.**

Keratitis in herpes ophthalmicus. See **Herpes zoster ophthalmicus.**

Keratitis, Inoculation. This term is generally used to indicate animal experiments—especially those of Leber—on the cornea, various cocci being introduced into the cornea, and the results noted.

Keratitis, Internal. See p. 3380, Vol. V, of this *Encyclopedia.*

Keratitis, Interstitial. See **Keratitis parenchymatous.**

Keratitis, Lagophthalmic. See **Keratitis e lagophthalmo.**

Keratitis, Lattice-like. See p. 3364 and p. 3382, Vol. V, also p. 6282, Vol. VIII, of this *Encyclopedia.* It must also be remembered that this term is occasionally confounded with *grill-like keratitis*—quite another condition.

Keratitis, Leprous. See p. 3383, Vol. V, of this *Encyclopedia.*

Keratitis, Luetic. See **Keratitis parenchymatous.**

Keratitis, Lymphatic. See **Keratitis, Phlyctenular.**

Keratitis, Macular. A synonym of superficial punctate keratitis.

Keratitis maculosa. (L.) Macular keratitis.

Keratitis, Malarial. Keratitis dendritica.

Keratitis, Marble-worker's. This form of marmorokoneosis is, like harvester's keratitis and oystershucker's keratitis, a post traumatic infection; in this case from marble-dust irritation of the cornea plus subsequent bacterial invasion. Trantas (*Ophth. Year-Book,* p. 148, 1910) observed gray-red streaks in the left cornea, especially in right-handed workers (who hold the chisel in the left hand) and in the right corneæ of left-handed workmen in hard marbles. On the other hand, workers in soft marbles show no corneal deposits or opacities.

Keratitis, Marginal. There are two forms of marginal keratitis. See **Keratitis, Marginal, Deep**; and **Keratitis marginalis superficialis.**

Keratitis, Marginal, Deep. Fuchs [*Text-Book of Ophthalmology* (Duane), p. 285], who first described this rare disease says: "It gen-

erally affects old people, and occurs for the most part in one eye only, rarely in both. There forms upon the margin of the cornea, with moderate symptoms of irritation, a gray, later grayish-yellow, or even purulent-yellow opacity, which directly adjoins the sclera and hence extends under the limbus, while on the other hand it reaches for a distance of 1 or 2 mm. into the transparent cornea. This marginal zone of opacity generally embraces from one-third to one-half of the circumference of the cornea (most frequently the upper part), or in rare instances surrounds the entire cornea. The surface of the cornea over the opacity is somewhat dull, but shows no loss of substance, and never any exfoliation of epithelium. The limbus soon pushes forward so far as to cover the opacity with its vessels. The irritative symptoms disappear in from one to two weeks, while the marginal infiltrate is transformed into a permanent gray opacity of the cornea. This opacity bears a great resemblance to the arcus senilis, from which it is chiefly distinguished by its not being separated by a transparent zone from the scleral margin, but passing into the latter without any clear line of demarcation. Iritis does not occur in connection with this affection of the cornea, nor does ulceration of the cornea, as a rule; only twice have I seen small superficial ulcers develop upon the cornea. On account of the marginal situation of the residual opacity, this form of keratitis is without danger to the sight.'' Isakowitz and Meyerhof each report a typical case. The clinical histories of the two cases were strikingly similar. The attack began with symptoms of corneal irritation; there was pericorneal injection, small pupil, but no iritis. Small peripheral yellow foci first appeared, fusing in a few hours to form a yellow line parallel to the limbus, and in one case completely encircling the cornea. In three days all inflammatory signs had disappeared, only a faint nebulous line was left and the vision was unaffected. The threatening aspect of the corneal infiltration with its rapid progress toward a favorable termination are the surprising but constant characteristics of this disease. Its etiology is unknown. Although Fuchs says it occurs in old persons, Meyerhof's case was in a healthy man aged 38 and was monocular. Isakowitz' case was in a robust man of 47 who had recently suffered from carbuncle of the neck. Both eyes were affected, the second one a month later. Staining of the endothelium and parenchyma was obtained but not in the early stages.

The *treatment* is that of simple ulcer of the cornea.

Keratitis, Marginal epithelial, flame-shaped. See p. 5221, Vol. VII, of this *Encyclopedia*.

Keratitis marginalis periodica fugax. Such, according to the reviewer (*Ophthalmic Review,* p. 17, 1914) is the name that Attias (*Archivio di Ottalmologia,* XXI, 1913) proposes for a type of inflammation of the cornea which, both in aspect and in history, differs from any published description which he has observed. A man of 32, who enjoyed excellent health, save for a slight attack of appendicitis some months previously, appeared to be in a perfectly sound state. Neither history nor examination gave any suggestion of syphilis or tubercle, and the urine was quite normal.

About seven years previously the patient began to suffer from pains in the upper part of the right eye, the pains returning constantly every two to three months; a little redness came on with each attack. Three years previous to the time when Attias saw him a small nebula formed at the upper side of the cornea; at that time the attacks of pain and redness were returning at regular intervals of thirty to thirty-five days, and lasting two or three days. Later, the intervals became reduced to twenty-five days. By this time (1912) the nebula had enlarged to some extent and had acquired a peculiar form, and the intervals became further reduced to twenty, to fifteen, and then to twelve days: the attacks themselves lasted from twenty-four to thirty-six hours. The pain and redness invariably came on simultaneously and the patient was always much relieved when the eye was kept closed: all this time vision remained good in each eye. In the spring of 1913 the bulbar conjunctiva above was somewhat tumefied, and numerous vessels ran from it over the corneo-scleral margin into the superficial layers of the cornea in the region at which the opacity lay. Elsewhere the conjunctiva and cornea were of normal aspect. The opacity itself lay in the upper part of the cornea, running ''parallel'' with the limbus and about 2 mm. within it, for about one-third of the circumference: it was of a white color. At the outer end particularly, this opacity assumed the form of a ''V'' between the limbs of which numerous very fine superficial vessels appeared; the nebula was entirely superficial and its margins sharp and clearly defined. In the affected area of the cornea sensitiveness was enhanced. The left eye showed a similar condition, but the opacity was only about 3 mm. in length, and more delicate; it also was situated at the upper part of the cornea; this eye had had only one attack of pain. When the pain in the right eye had ceased, careful examination showed that not only was the injection diminished but the sensitiveness was actually below normal. Vision remained unaffected.

The peculiar points in the case are the regular recurrence of symptoms, the short periods of actual inflammation, the complete absence

of any trouble between times, and of any ulceration. From simple superficial marginal keratitis, of which superficial ulceration is a feature, it is thus differentiated in the absence of ulceration, in the youth of the patient, and in the complete freedom from symptoms between the attacks. From chronic peripheral sulcus ulcer of the cornea (of Schmidt Rimpler) it differs also, while in Junius's dystrophia marginalis corneæ, though his patient also was young, there was no periodical inflammation and a partial ectasia came on.

Keratitis marginalis profunda. (L.) See **Keratitis, Marginal, Deep.**

Keratitis marginalis superficialis (Fuchs). This rare form of keratitis is characterized by a spreading ulceration, beginning at different sections of the limbus, where the extremely small ulcerative foci are confined to the superficial layers of the cornea. It develops very suddenly and is sometimes accompanied by violent complications. The disease is characterized by recurrences and several relapses may occur during the same year. It is most frequently observed in the male sex, during middle life.

The lesions begin at the corneal margin, appearing as faint epithelial infiltrates which do not progress uniformly. The areas of infiltration are shallow and decidedly grayish in color. A fine gray line between the transparent cornea and the zone of ulceration is one of the peculiar anatomical features. It never reaches the center of the cornea, therefore the disease has no effect upon the vision. It is not unlike pterygium in appearance, when the conjunctiva advances over the corneal margin. The cause of this disease is obscure.

The symptoms common to this form of keratitis are comparatively mild, but when complications develop (which are rare), they are violent, but not destructive in nature.

Treatment. Nitrate of silver, yellow oxide of mercury or powdered calomel are remedies commonly employed in the treatment of this disease and are effective in some instances, but the sliding flap operation (See **Conjunctivoplasty**; as well as Vol. V, p. 3456, of this *Encyclopedia*) is the most approved means for terminating the disease. —(J. D. L.)

Keratitis, Marginal phlyctenular. A variety of the usual form of phlyctenular keratitis in which a number of phlyctenules develop along the corneal margin.

Keratitis, Mold. See **Keratitis, Aspergillus.**

Keratitis, Mycotic. Furrow keratitis. See **Cornea, Dendritic ulcer of the,** also **Keratomycosis.**

Keratitis, Nasal. This is a rare form of corneal infection, although two cases of keratitis of probable nasal origin are reported by Risley. In both there was cloudiness in the deeper layers. One case got well

on the removal of polypi, the other after the removal of a large rhinolith.

Keratitis neuroparalytica. Trophic keratitis. Desiccation neuritis. Exposure keratitis. Neuropathic keratitis. The clinical features of this disease are so characteristic and unlike those of other forms of keratitis, that the manifestations are readily differentiated.

The first ocular sign is a general anesthesia of the cornea and conjunctiva. The onset of the pathologic manifestations is marked by a dull and nepheloid appearance of the central portion of the cornea. In the early stages the opacity is uniformly gray. As the process extends in area, the cloudiness at the original site (central) becomes more pronounced, fading out toward the periphery, where, when viewed through the loupe, it is seen to be composed of numerous maculæ. Coincident with the above changes, a depression in the epithelium appears at the summit of the cornea, which gives to it the same appearance as observed when the epithelial layer has been exfoliated. The area of depression gradually extends toward the periphery until only a narrow border, 2 to 3 mm. wide, of epithelium, of normal thickness, remains at the margin of the cornea, one of the distinguishing features of the disease. The opacification, which at the onset was gray, now assumes a yellowish color, indicating incipient necrosis of the central portion of the cornea. When the corneal lesion is complete, hypopyon appears, the disintegration of the center of the cornea increases, pus accumulates therein and the clinical image is one of a large corneal ulcer. The ulcer either cicatrizes with the iris incarcerated in the scar (leucoma adherens), or perforation, which occasionally happens, opens the way for intraocular infection and the eye is lost as a result of panophthalmitis with phthisis bulbi completing the disastrous process. The above description represents the definite clinical symptoms discernible in the course run in the severe forms; in the milder types of the disease the process disappears before purulent disintegration intervenes, yet even these leave permanent opacities and, frequently, some flattening of the cornea.

In connection with this trophic form of keratitis it is well to remember the nerve supply of the corneal neighborhood.

The first or ophthalmic division of the trigeminus (fifth nerve) is the smallest of the three divisions. It springs from the upper portion of the ganglion and is distributed to the forehead, integument of the eyebrow, lacrimal gland, nose, nasal fossæ, eyeball and conjunctiva. The delicate sensory filaments terminate in the bulbar epithelium and cornea.

Symptoms. The most constant symptoms are the general anesthesia

of the cornea, lack of defensive reflex lid movement and decrease of lacrimal secretion which may be regarded as quite pathognomonic of the disease. The irritative symptoms are either very mild or entirely absent. In some cases ciliary injection is pronounced. Lacrimation is absent, explained by the fact that the lacrimal secretion is diminished, or entirely suppressed, due to the reflex action upon the function of the lacrimal gland. Pain is entirely obtunded, owing to the paralysis of the trigeminus. However, pain may precede the corneal anesthesia. Decrease of tension is the rule.

Etiology. In no other disease of the cornea are the etiologic theories so numerous and varied as those of neuroparalytic keratitis. The true cause of the disease is still a subject of controversy.

Davies and Hall (*The British Med. Jour.*, Jan. 11, p. 72, 1908) in their exhaustive article, "The Bacteriological Aspects of the Problem of Neuroparalytica Keratitis," enumerate the several hypotheses, which have been propounded to explain the cause of this disease, as follows: (1) The purely trophic; (2) the trophic traumatic; (3) the trophic with peripheral irritation; (4) the vasomotor traumatic; (5) the purely traumatic; (6) the desiccation, and (7) the mycotic. These hypotheses, including an outline of the arguments for and against by the above authors, and those of other investigators in this field, will be discussed in the order set down by Davies and Hall.

(1) The purely trophic theory: A disturbance of the trophic nerve fibers travelling in the trigeminus and terminating in the cornea.

(2) The trophic traumatic theory: Wilbrand and Saenger, while of the opinion that preservation of the eye is measurably dependent upon intact trophic fibers, do not believe that neuroparalytic keratitis is the result of the destruction of these fibers alone. They regard the exciting cause as one of central irritation, either of the nerve roots or of the ganglion cells, and destruction of the trophic fibers merely a predisposing cause.

(3) The vasomotor theory: That vasomotor disturbances induce a vasomotor constriction of the ocular blood vessels, especially those situated at the corneal limbus, which occasionally eventuates in necrosis of the corneal tissues.

(4) The vasomotor traumatic theory: A primal disturbance of the sympathetic nerve, neuroparalytic keratitis developing as a secondary (exciting) condition, following traumata of the cornea, especially if the central portion receives an injury.

(5) The purely traumatic theory: That neuroparalytic keratitis is dependent for its development upon trauma of the cornea.

(6) The desiccation theory: Those who have advanced this hypothe-

sis believe the disease is the result of a decreased or entirely suppressed lacrimation, due to the reflex action upon the function of the lacrimal gland, and the lessening of the act of winking. As a sequence, the exposed portion of the cornea becomes dry and keratonecrosis results.

(7) The mycotic theory: That septic infection of the cornea occurs as a result of the impaired resistance to inflammation, the cornea yielding to whatever bacteria are present in the conjunctival sac.

Magendie (1824) was the first to advance the purely *trophic theory,* which was put forth following his experiments on rabbits, in which he observed the appearance of the disease after section of the trigeminus nerve within the cranium. He attributes the disease to trophic disturbances.

The trophic theory is based upon the supposition that the trophic fibers of the trigeminal nerve exert great influence upon the nutrition of the corneal tissues. Since the existence of the trophic nerve fibers has not been clearly demonstrated, considerable doubt has been cast upon this generally accepted hypothetical explanation. The experiments of Merkel served strongly to popularize the trophic theory. He observed keratitis in a rabbit, following injury to the ascending fibers of the trigeminus alone, in which there was no corneal anesthesia, and it has been assumed, therefore, that the ascending fibers of the fifth nerve are trophic in character.

Snellen and Senftleben, in opposition to Magendie's theory of trophic disturbance, argue that traumatism better explains the development of keratitis neuroparalytica, since it may be prevented by protecting the cornea. The question, whether the disease is due to sensory disturbances alone, or to trophic disturbances, is still an open one.

Consensus of present day opinion is to abandon the trophic theory and to consider the disease as an exposure keratitis brought about by an anesthetic cornea, suppression of lacrimation and the faulty mechanical action of the lids.

Only about one-third of all human beings, in whom trigeminal neurectomy has been performed, developed neuropathic changes in the cornea. Loss of the trophic fibers cannot be accepted as the sole cause, else removal of the Gasserian ganglion would always be followed by ocular disturbances. "If the keratitis is dependent on the loss of trophic nerves, how is it that when properly treated the condition clears up?" (Davies and Hall).

Bernard, later Gaule and several other investigators, by cutting the Gasserian ganglion across—especially at the anterior portion—observed the rapid appearance of neuroparalytic keratitis. Division

of the trigeminal root produced corneal anesthesia, but keratitis, if it supervened at all, was moderate in character and late in appearing.

Flemming (*The Lancet,* July 2, 1898, p. 19) in reviewing his clinical studies of five cases, arrives at the following conclusions: That the most likely explanation of them is that they are caused by perverted trophic action, such perversion being of the nature of irritation, the various other explanations suggested being inadequate to explain all cases. . . . Thus though it may be impossible to prove clinically that neuropathic keratitis is due to a trophic lesion yet such an explanation seems most probable. The further question then arises—viz., whether such trophic action is to be viewed as one of paralysis or as one of irritation. The clinical evidence points most strongly to the process being one of irritation. In the first place, cases of herpes are associated with neuralgic pain; in the next, a history of preceding neuralgia is very commonly to be obtained in cases of trophic keratitis, even though the cornea be anesthetic at the time when the keratitis supervenes; thirdly, aseptic removal of the Gasserian ganglion, with healing by first intention, is not necessarily followed by keratitis even though the eye be not protected; and finally (and perhaps most important) cases are frequently met with in which a condition of iritis may precede the keratitis.

Parsons (*The Lancet,* May 25, 1907, p. 1415) says that researches, in fact, bring forward strong evidence in support of a theory already suggested by Wilbrand and Sänger—viz., that neuroparalytic keratitis is due to irritation of the distal end of the cut or diseased trigeminal nerve. This theory explains better than any other all the diverse clinical facts which have accumulated. It explains the absence of keratitis in those cases in which it does not occur. Neuroparalytic keratitis may occur in association with retained corneal sensibility. Here the afferent tract is still open, but an irritative lesion has set up abnormal antidromic impulses in the protopathic system. There may be hyperesthesia of the cornea with keratitis. Here not only is the afferent tract open, but it is subject to abnormal stimulation either at the periphery or at the site of the lesion, and abnormal antidromic impulses are also set up. There may be anesthesia dolorosa. This is due to irritation of the proximal end of the cut or diseased nerve, whilst antidromic impulses are set up in the distal section.

The *vasomotor hypothesis* was first advanced by Shiff (1867) who attributed the inflammation to the paralytic influence of the vasomotor nerves upon dilatation of the blood vessels. Sgrosso (*Arch., di Ottalmol.,* Vol. 21, p. 241) concludes, from a series of experiments in rabbits, that the appearance of neuroparalytic keratitis results

from influences exerted upon the highly vascularized structures, which, in turn, impairs nutrition. These phenomena, he explains, are due to functional disturbances of the blood vessel walls, for which insensibility of these tissues and paralysis affecting the smooth fibers, depending upon similar disturbances in the vascular fibers of the trigeminus, are the responsible factors.

There is strong evidence to support the claims of several investigators, particularly Turner and Krause, who regard the development of neuroparalytic keratitis, following removal of the Gasserian ganglion, as the result of the attending impairment of the resistive forces of the cornea to inflammatory influences, trauma being only a contributory exciting cause. The same injury would quickly heal in an eye with unimpaired nerve supply; when more advanced, microbic invasion occurs and easily gains a victory over the eye whose combative powers have been weakened.

The *desiccation theory* is based upon the following etiologic factors: (1) As a result of trigeminal paralysis, the lower central portion of the cornea is deprived of protection owing to abolishment of the reflex action of the orbicularis; (2) The diminished or entirely arrested lacrimal secretion; (3) As a result of the two former functional disturbances, predisposing to dryness of the cornea, keratinization (clinically termed xerosis) occurs. Excoriation of the corneal epithelium layer paves the way for microbic infection.

The view of Feuer, that in animals exposure of the cornea from absence of movements of the lids, on the side on which the trigeminal nerve is divided, is the causative factor, has many supporters. In opposition to this theory, Fuchs remarks that in this case animal experimentation is not conclusive in the case of man because:—(1) In man the reflex movements of the lids are always bilateral and hence take place as often on the side on which the trigeminus has been divided as on the other; (2) neuroparalytic keratitis is observed even in cases in which either the eye has been protected by a bandage from the start (e. g., after extirpation of the Gasserian ganglion) or in which it has been kept permanently covered by reason of there being an associated ptosis; (3) the clinical picture of a genuine keratitis neuroparalytica is entirely different from that of keratitis e lagophthalmo.

The *mycotic theory* has many advocates. This hypothesis is based upon the belief that impairment of the corneal resistance to inflammation, predisposes to septic infection.

In reviewing the manifold theories which have been advanced to account for the genesis of neuroparalytic keratitis, it is evident that most authorities are agreed on one etiological point, to-wit, that some

morbid disturbance (paresis or paralysis), peripheral or proximal to the Gasserian ganglion, nerve roots, or branches of the trigeminal nerve, is a primary and fundamental requisite to development of the malady. However, numerous cases have been related in the literature in which it was not possible to prove the existence of a lesion of any part of the trigeminus.

Power and Murphy (*A System of Syphilis*) attach great importance to lues as the cause of this disease. When a gummatous process involves the ganglion or the ophthalmic division of the fifth nerve, a neuropathic keratitis may occur.

With reference to diseases, which may involve the Gasserian ganglion, or the division of the trigeminal nerve, Powers and Murphy say: "Gummata about the base of the brain or gummatous meningitis or syphilitic diseases of the base of the skull may affect the Gasserian ganglion or any or all of the three divisions of the nerve—and obviously a basic meningitis may involve the trunk of the nerve fibers proceeding from the ganglion to the side of the pons."

Uhthoff's statistics indicate an involvement of the trigeminal nerve in about 14 per cent. of all cases of cerebral syphilis—almost always associated with contemporary affections of the optic nerves and those which supply the ocular muscles. He makes a definite statement that the following factors are the principal causes of trigeminal lesions—local hemorrhage, cachexia, orbital periostitis, caries of the temporal bone, tuberculosis or lues affecting the trigeminal nerve, neoplasms, fracture of the skull (Dutoit), brain tumor and operations on the Gasserian ganglion, and toxic effect of drugs, especially salvarsan (Bruere).

Weidler (*N. Y. State Jour., of Med.*, Oct., 1912) directs attention to the frequent deplorable ocular complications which follow Gasserectomy, performed for the relief of trifacial neuralgia, and strongly urges that alcohol injections be substituted. In comparing the results of the two methods, he points out that there have been more than three hundred cases treated by the injection method, unattended by any serious ocular lesion, except in one case.

Prognosis. Insofar as vision is concerned, the prognosis, in typical cases of this disease, is unfavorable; the scar tissue is often so dense and extensive as to bring about a most serious impairment of vision. In a few cases reported, resolution has been comparatively prompt and the visual impairment slight. Appropriate treatment, the patient's general condition and the virulence of the offending organisms present in the conjunctival sac, naturally have considerable bearing on the

course of the disease and the amount of vision retained, as well as on the preservation of the eyeball.

Treatment. The severe forms are not amenable to treatment, as the process continues uninterruptedly until the cornea is rendered permanently opaque, or the eyeball is destroyed as a result of complications previously mentioned. Atropin is useful when iritis intervenes. Bandages, shields, or suturing the lids together, will occasionally exert a beneficial influence upon the course and extent of the disease. Dionin, 2 to 5 per cent., has rendered beneficial service in some cases. In a case of trachoma with corneal erosion, ascribed to trophic disturbances of nervous origin, Dor effected a cure by instillations of cuprol.—(J. D. L.) See, also, **Ganglion, Gasserian**; as well as p. 5194, Vol. VI of this *Encyclopedia.*

Keratitis, Neuropathic. See **Keratitis, Neuroparalytic.**

Keratitis, Nodular. FAMILY KERATITIS. See **Cornea, Nodular opacity of the,** p. 3410, Vol. V, also p. 5823, Vol. VIII, of this *Encyclopedia.*

Keratitis, Nummular. A synonym of superficial punctate keratitis.

Keratitis, Oystershucker's. As pointed out by Robt. L. Randolph and others, oyster openers (shuckers) are subject to a form of keratitis set up by small particles of oyster shells striking the cornea and producing ulcers. Randolph has shown that the disease depends upon the irritating chemical ingredients in the shell, and not upon microorganisms. It is best treated by atropin and mild antiseptic lotions.

Keratitis, Panel-like. STRIPED (STRIATE) KERATITIS. See, also, **Iridocyclitis,** especially under *plastic iridocyclitis.* This term is sometimes used as synonymous with *grill-like keratitis.*

Keratitis parenchymatosa circumscripta. See **Keratitis, Central parenchymatous.**

Keratitis, Parenchymatous. INTERSTITIAL, INHERITED, LUETIC, STRUMOUS OR DIFFUSE KERATITIS. ANTERIOR UVEITIS. This is a disease essentially of the middle and deep layers of the substantia propria of the cornea, characterized by a leucocyte infiltration of the corneal parenchyma, which either attacks the structure at its central portion, primarily, or begins at the periphery and later extends to the center. The number of maculæ, few at the onset, gradually increases until, in the severe cases, they become confluent, so that no part of the cornea remains translucent and the iris becomes entirely obscured. When the infiltration is complete, the cornea has the appearance of ground glass. Needless to say, at this stage of the disease, vision is reduced to counting fingers or even to movements of the hand before the eye. Accompanying this clinical picture we see blood vessels extending from the limbus, situated in the deep layers of the cornea, gradually

lengthening and branching as they approach the center. The above changes can be observed by the use of the loupe, or by the method proposed by Stephenson; that of a plus 20 spherical lens placed behind the concave mirror of the ophthalmoscope, which reveals the multiple maculæ in the opalescent zone, or numerous indistinct streaks running parallel to each other.

Dimmer (*Zeitschr. f. Augenheilk.*, Vol. 4, p. 251) classifies the streaks or stripes appearing in keratitis parenchymatosa as (1) those appearing in the florid variety of keratitis, which are gray and later disappear; (2) the permanent striped opacities occurring when the disease is well advanced, due to wrinkling of Descemet's membrane, for which corneal edema or a decrease of intraocular tension is responsible. The loops of blood vessels, being situated at the limbus, give to the cornea an appearance of reduction in size.

In the primary parenchymatous keratitides of late hereditary syphilis, there is a mutation of the fixed and migratory corneal cells, absence of lymphocytic immigration, but the corneal lamellæ become necrosed.

Regression of the infiltration always begins at the limbus and, therefore, the cloudiness at the center of the cornea is the last to disappear; sometimes its presence can be observed for years afterward and again small opacities and blood vessels may remain permanently. The disease has, only in rare instances, ended in sclerosis of the cornea. The nature of this disease is sometimes mild, the maculæ few and the inflammatory symptoms passive or absent altogether, as in two cases reported by Elschnig and one by F. A. Davis. In the mild cases, the opacity at the margin of the cornea may never extend to the center. When the deposits form an opaque ring, the condition was termed by Vossius *keratitis centralis annula*, (q. v.). Morax and Pfister do not agree with Vossius and Grunert in placing the annular form in a separate catagory aside from the present classifications of keratitis. Keratitis parenchymatosa of this character, therefore, is of shorter duration and the original transparency of the cornea returns more rapidly. There are severe cases in which the condition is attended by softening, and the cornea yields under the intraocular pressure, producing the condition of *keratectasia*, which always leaves the corneal tissues permanently opaque. Conversely the cornea may become flattened and densely opaque; in event of either, the vision is reduced to almost complete blindness. As early as 1869, von Graefe directed attention to the importance of the intraocular tension, which is usually reduced, but, in a few instances, an increase has occurred. Other authorities have confirmed these observations.

When parenchymatous keratitis develops by the advancement of capillaries from the sclerocorneal junction into the deeper layers of the corneal tissues, there appears a uniform, pale-red, vascularized area commonly known as a "salmon patch." See **Keratitis, Vascular, Deep.**

The amount of vascularity is usually in keeping with the density (saturation) and the area of the infiltration. In severe cases, the entire cornea presents a reddish appearance, while in others there may be considerable infiltration accompanied by slight vascularization. Hence we have two forms, the *vascular* and the *non-vascular.*

A distinctive feature of this disease is that ulceration never occurs (Fuchs). The symptoms common to keratitis, such as pain, photophobia and lacrimation are usually very mild, occasionally entirely absent. Sometimes, of course, they are quite tempestuous in nature when the irritative symptoms are very pronounced, especially when the vascularization is well marked. Owing to the fact that deep scleral vessels are involved, the tissues of the uveal tract share in the inflammatory process; in fact many observers hold that the corneal infiltration is always secondary to uveitis, a claim, however, which has not generally been accepted. Marshall has demonstrated, by extensive microscopic investigations, what has long been clinically held by the claimants of this theory, that the so-called interstitial keratitis is not a simple keratitis, but really a manifestation of uveitis.

He pointed out that the presence of the disease almost always first manifests itself in the form of a serous iritis, and that the iris, ciliary body and choroid are always involved. These are reasons why he strongly favors atropin as the chief local remedy, particularly in the early stages.

In many cases of keratitis parenchymatosa the epithelial layer shows a positive fluorescein reaction, and, according to Graflin, the endothelial layer is commonly involved in this inflammatory process and this investigator seems to have conclusively proved, by positive fluorescein staining, that in at least many cases, the opacities of the cornea have their origin in this membrane.

In the several types, previously referred to, the accompanying inflammation of the uveal tract (irido-choroiditis) may mask the signs by the formation of posterior synechiæ (seclusion or occlusion of the pupil), or terminate in flattening of the cornea, or progress until atrophy of the eyeball results.

Both eyes are usually involved, although there may be long intervals between the attacks, for which reason the duration of the disease may extend over years.

Igersheimer has added greatly to the present knowledge regarding the ultimate effect on vision. In a report covering 152 eyes in patients affected with the hereditary form, he found in those who had many years previously been afflicted, only 59.2 per cent. retained from 5/4 to 5/10 V., i. e., good sight, others had sufficient, from 5/15 to 5/25; in the remainder, 50.8 per cent., the vision was poor, 5/35, which amounted to almost total blindness insofar as occupation was concerned. Myopia, which he regards as probably acquired, was present in one-third of the patients. Increase and decrease of tension occurred about equally often, a finding which is not in accord with the observations of the older clinicians, who seem rarely to have detected an increase of intraocular tension. Since the advent of the tonometer, the occurrence of hypertension is shown to be a more frequent accompaniment of parenchymatous keratitis than was previously supposed. Igersheimer advises the use of the tonometer as a means for controlling the effects of atropin on the tension. He considers the tension as of great importance in the management of this disease. Mild relapses occurred in 14 per cent. of his reported cases.

The visual prognosis is more favorable in the young and in proportion to the age of the afflicted. Ordinarily, in the younger subjects the disease is not attended by any permanent visual impairment, the opacities frequently clearing without a trace remaining, although years after the case has been cured—indeed through life—the empty lumina of adventitious vessels may generally be distinguished, by the corneal microscope or Coddington lens, especially if the pupil be dilated, running beneath the anterior corneal layer. Relapses may occur after intervals of months or even as late as 10 or more years following the initial lesion.

Etiology. Stephenson finds the disease occurring most frequently at the tenth year and rarely after the twentieth. He has seen only three cases after 30. In 97 cases, 45 were between 5 and 15 years. Parinaud found the disease present before birth, and Fernandez after the 45th year. Cases have been recorded as late as the 60th year. Fernandez's (*Ophthalmology,* Vol. X, No. 2, p. 215, July, 1914) observations, with regard to age, differ from those of other writers. Out of 387 cases of parenchymatous keratitis, 8 were in persons past 45 years and many were in subjects past 20. A rugose appearance was observed in 15 of his cases. The climate of Cuba may account for this age difference. The disease, in the temperate zone, occurs most frequently between the fifth (rarely earlier) and the twentieth year.

Panas says, "Every keratitis originating in the parenchyma is dependent upon a diathesis." Hutchinson (1857) in contradistinction

to the previously accepted theory that corneal involvement could not be produced by syphilis, advanced the now well authenticated opposite doctrine. v. Graefe, a year later, still held to the former view, and many years elapsed before Hutchinson's claims were generally accepted. While the disease cannot be considered as pathognomonic of congenital syphilis, it is, however, the most frequent ocular manifestation. Stephenson states that in about two-thirds of the cases hereditary syphilis is responsible, but many cases (more than one hundred), due to acquired lues, have been recorded, with few exceptions, in the foreign literature—the paucity of American reports upon the subject being conspicuous. Fournier (*Traité des maladies des Yeux,* edited by Panas, Vol. 1, p. 245, 1894) says the disease is not the direct manifestation of syphilis, but the result of dyscrasia induced thereby. Mauthner regards the disease as a gummatous infiltration of the cornea. Morax (Keratite interstitielle au cours des tryspanasomises; *Soc. d'Ophtalmologie de Paris,* Oct. 9, 1906) believes the corneal lesions are directly due to a proliferation of the parasites (trypanosome) between the layers of the parenchyma. Beauxvieux *Archives d'Ophtalmologie, Octobre,* 1910) states there are few exceptions in which interstitial keratitides are not due to inherited syphilis, or at least specific in nature or induced by acquired lues.

Several investigators Bossalino (*Ann. di Ottalmol.,* Vol. XXXVIII, No. 12, 1909), Levaditi and Yamanouche, induced keratitis parenchymatosa in rabbits by inoculating the cornea with treponema. Bossalino inoculated rabbits with human syphilis and produced a true parenchymatous keratitis which extended to Descemet's membrane and the endothelial layer only when the uveal tract became involved. Elschnig, Reis, Stock and von Hippel consider luetic parenchymatous keratitis as *primary,* i. e., the corneal lesion is the direct result of the general infection. Elschnig and Reis ascribe the occurrence of the disease to the action of toxins but believe that the active agent is the spirochæte pallida. von Hippel (Graefe's *Arch.,* LXVIII, Pt. 2, May 17, 1908) was the first to record the findings of the spirochæta pallida in the cornea of a patient affected with keratitis parenchymatosa. The case was a 33 weeks, congenital syphilitic fetus. This discovery may have a decided bearing upon the etiologic theories so far advanced. The entrance of the parasite into the cornea may be preliminary to the inflammatory condition. The spirochæta pallida has been found in the seemingly healthy tissues of the eye in specific infants and fetuses (Bab, Peters, Stock and Stephenson). Terrien observed the appearance of parenchymatous keratitis in dogs, following injections of tetanus toxin into the vitreous. He believes the condition was in-

duced by pathological changes of the uveal tract, principally in the vessels of these tissues. In rabbits, the disease can be produced by the injection of material charged with spirochæta into the body and by clear cultures into the blood vessels. From the cornea of rabbits thus injected, spirochæta were recovered (Igersheimer). Clausen carried out similar experiments in rabbits and pavians, recovering an abundance of spirochæta in the cornea. He agrees with E. Hoffmann that these experimental keratitides are to be looked upon as primary syphiloma of the cornea and cannot be regarded as parallel to parenchymatous keratitis in man—which is of metastatic hematogenous origin and, developing as it does, years after the infection, is explained by the action of toxins rather than spirochæta. Since neither the aqueous nor the cornea ever contain spirochæta in the interstitial keratitis of man, it may be classed as a so-called metasyphilitic disease, brought about by toxins circulating in the blood, or from previous syphilitic lesions.

There does not seem to be any, or, at most, slight, clinical difference between parenchymatous keratitis caused by inherited and acquired syphilis. Usually the vascularity is less pronounced than in the hereditary form. Wilder (*Jour. Am. Med. Assn.*, Dec. 21, 1901) cites three cases of acquired luetic keratitis and with reference to the clinical differences of this and the inherited form says: "The clinical features of acquired syphilitic keratitis vary. Different writers have described cases of diffuse interstitial keratitis differing in no essential particulars from the lesion as seen in inherited syphilis, except that it is more frequently unilateral, and the degree of vascularization is much less. Iritis may or may not be associated with this form.

More distinctive, however, is the form in which the lesion develops at some point of the corneal circumference as a rather dense, grayish infiltration which remains limited to this part of the cornea passing through all its phases with no tendency to ulceration. Sometimes, the dense, opalescent opacity may extend quite up to the margin of the cornea and appear to be merged in the sclerotic; in other cases there may be a clear space between the site of the lesion and the limbus. In this form of the disease vascularization is not a prominent feature and is absent in most of them. This point is emphasized by Boucheron, Terson, Chevallereau and others. Iridocyclitis and choroiditis may be associated with this condition, so that this form may be the same as that described by Mauthner and Antonelli under the name of keratitis interstitialis punctata."

Mendel's (*Centralbl. f. prakt. Augenheilk.*, XXV., p. 10) interesting case was one which was treated for syphilis at birth and yet ac-

quired a chancre in his twenty-second year. A diffuse bilateral keratitis appeared six years later with salmon patches at the upper margin of both eyes. A relapse occurred in the right eye six years later as a typical specific episcleritis involving the cornea. The disease again disappeared. Numerous deep corneal vessels were present as in the acquired manifestation. Carpenter (*Ann. Ophthal.,* Oct., 1908) found in about 19,000 cases in private and clinical practice, only three cases of keratitis parenchymatosa from acquired syphilis.

Clausen (von Graefe's *Arch. f. Ophthal.,* 83, III, p. 399) notes that in approximately eighty-five per cent. of the cases a positive Wassermann reaction was obtained, which tests frequently remain positive after the most energetic antiluetic treatment, a phenomenon in contrast to that of acquired lues, and one that suggested to him the presence of parasyphilitic noxious matter or toxins, and, not, therefore, the result of spirochæta, as held by Igersheimer.

Even slight trauma has been known to precipitate an attack in individuals hereditarily predisposed to tuberculosis and in those who have inherited syphilis. Mohr, out of 670 cases found trauma as the probable cause in all except two. In these he obtained a positive Wassermann reaction.

The condition of the upper incisor teeth (microdontia), called Hutchinson's teeth, is a frank symptom of lues hereditaria tarda, also there are certain peculiarities in the formation of the face and cranium. Suker (*Ophthalmic Record,* Vol. XXI, No. 6, p. 289, June, 1912) examined the literature on this subject and was unable to find a single case reported in which there were not present in the teeth some markings characteristic of inherited lues. The permanent teeth, particularly the molars, are most commonly marked, the incisors not necessarily showing the typical characteristics. The molars are more frequently affected. The enamel of the four cusps is wanting and dentin pegs are noted on the surface of the tooth and, in time, the tooth becomes worn down to a flat surface. The so-called Fournier teeth are not necessarily separated, pegged or notched. In every case of interstitial keratitis, the first permanent molars showed markings. Their peculiarities are so well known and easily recognized that to point out their striking characteristics seems unnecessary. Persistence and permanency of the first teeth, far beyond the usual period, is considered of special significance by Fournier.

Interstitial keratitis and a vertically oval cornea, according to Fuchs and Rübel, are frequently associated with hereditary lues. Komoto (*Nippon Gankagakkai Zasshi,* Nov., 1912) confirmed this characteristic peculiarity in some forms of the disease.

It must also be remembered that *keratitis punctata vera* (q. v.) is characteristic of the eye due to congenital syphilis. In addition to the above stigmata, impaired hearing is not a rare occurrence.

Leber states that ninety per cent. of all eye diseases due to hereditary lues react positively to the Wassermann test. M. Cohn says that in seventy-five per cent. of the cases of interstitial keratitis, with clinical manifestations of lues, the Wassermann reaction and the luetin test correspond. Other causes of keratitis parenchymatosa are tuberculosis, influenza, malaria and arthritis. It is now a well established fact that tuberculosis is the underlying etiologic factor in certain cases of parenchymatous keratitis, extending to the cornea from other ocular tissues, i. e., it is a *secondary* manifestation. There is abundant histo-pathological information to support this contention.

Recent ophthalmic literature contains a number of reports of microscopic examinations made of the eyes of congenitally luetic fetuses, in which the spirochæta was frequently found, either in the clear or in the parenchymatously inflamed portion of the cornea. Igersheimer repeatedly recovered spirochæta from the corneæ of congenitally luetic fetuses and infants which, he states, may be present in the corneal tissues for many years without exciting inflammation. Clausen believes that the spirochæta found in the cornea of fetuses and newborn children, has no bearing, for comparison, upon the etiology of interstitial keratitis. Leucocytes were numerous but only slight changes were noted in the corneal corpuscles. Trypanosomes, closely related to the spirochæta, are sometimes found in the cornea and there are reasons for believing these parasites may endogenously produce parenchymatous keratitis, which, in the animal experiments, was marked by a liberal immigration of lymphocytes and leucocytes and slight changes of the fixed corneal cells. In the primary parenchymatous keratitis of lues hereditaria tarda, there was a mutation of fixed and migratory cells, absence of lymphocytic immigration, although the corneal lamellæ show necrosis. Igersheimer concludes from the above facts that in animals, fetuses and the new-born, spirochæta are the sole cause of parenchymatous keratitis. He, as von Hippel previously, found a typical spirochæta pallida in one case, but failed to determine their presence in five trephined pieces of the cornea. Clausen, in eleven attempts, was also unsuccessful.

Enslin, in a series of patients having keratitis parenchymatosa, applied the tuberculin test with the following results: Where the manifestations of hereditary lues were well marked and the signs of tuberculosis wanting, no increase in temperature followed, except in one instance; in cases where it could be excluded and evidences of

tuberculosis were present, or, in cases where both were present, a general reaction occurred.

Risley believes that, aside from the large majority of cases due to inherited lues, there are many which result from diseases of nutrition. His observations in cases of inherited lues, traced to the second and third generations, have led him, in some cases, to regard the disease as an incidental manifestation of the faulty metabolism.

Treatment. In ordinary cases, for reasons inherent in the pathologic changes, keratitis parenchymatosa is not amenable to local treatment, at least it seems to have little or no effect upon the disease. However, considerable can be done to prevent extension to deeper tissues. Atropin is very useful as a means of combating the onset of iritis or irido-cyclitis and preventing their ruinous sequelæ. Dionin exerts a marked beneficial influence upon the pain and photophobia. Fernandez prefers calomel in fractional doses of from a quarter to one centigram (by mouth) several times a day or on alternate days or every third day. Dark glasses or eye shades add to the patient's comfort. Hot compresses exert a beneficial influence upon pain and absorption. Bandaging is indicated only when ectasia of the cornea seems imminent. General treatment of this disease naturally leads to its causes; if luetic, mercury is the standard and calomel gr. 0.1 four times daily seems to produce the best results. Specific treatment is administered by inunction, internally, or by intramuscular injections. During the inflammatory stages, the administration of iodides is not recommendable. Stephenson advises the use of atoxyl, (a combination of arsenic and anilin) given in conjunction with mercury, as a very efficacious remedy. He advocates the intramuscular injection of atoxyl in doses of from 0.25 to 0.50 gram—that is 3¾ to 7¾ grs., repeated once a week in mild cases and more frequently when the disease is very active. Not more than 6 grams should be given in all.

Stephenson has reported a number of cases in which comparatively rapid cures have resulted from these agents. A course of twelve injections usually sufficed to cure all cases, results more brilliant than others have achieved with this remedy.

Since parenchymatous keratitis is induced by the action of toxins, originating from foci of spirochætæ somewhere in the body and circulating in the blood stream, which activate the spirochætæ present in the cornea, or produce an anaphylactic keratitis, Igersheimer believes is a rational explanation for the negative results of antiluetic therapy. The alteration in the corneal cells is frequently so pronounced that absorption or regeneration is necessarily a slow process.

In acute cases, salvarsan sometimes produces remarkable results,

but has not dethroned the classical mercurial treatment in the delayed (latent) stages of lues. Wessely, Clausen and Löhlein believe that salvarsan does not possess any therapeutic advantage over the administration of mercury. The results of salvarsan and neosalvarsan treatment, in a series of ten cases reported by Wallis (*Ophthalmoscope*, June, 1913), in patients whose ages ranged from thirteen to thirty years, and the duration of the disease varying from four to thirty-two weeks, were disappointing when only one or two doses had been administered. However, after the third or fourth injection, the hazy cornea began to clear, ciliary injection and photophobia subsided and the pupils dilated. Wallis administered a full dose to the adult patients; in children in proportion to age. He believes, contrary to the views of others, that salvarsan therapy is of benefit in a considerable number of cases, adding, however, that it has no prophylactic effect on the unaffected eye. Hillion's results were similar. As a rule, he gave the injections at two months intervals. Darrier, Uhle, Patterson, Aufmwasser and Golesceano report beneficial results following the repeated administration of salvarsan. In children, corrosive sublimate is the preferable mercurial preparation for internal administration. Graflin's results, following the administration of Fowler's solution, were very satisfactory in some cases. Cohn thinks well of hetol and cocain in a 1 per cent. solution as a treatment of acute and subacute forms of parenchymatosa keratitis. A course of twelve injections usually sufficed to cure, or almost cure, all cases.—(J. D. L.)

Keratitis petrificans. See **Cornea, Calcareous degeneration of the,** as well as **Cornea, Lime incrustations of.**

Keratitis, Phlyctenular. VASCULAR KERATITIS. PHLYCTENULAR OPHTHALMIA. FASCICULAR KERATITIS. LYMPHATIC KERATITIS. STRUMOUS OPHTHALMIA. SCROFULOUS KERATITIS. PUSTULAR KERATITIS. PHLYCTENULAR KERATO-CONJUNCTIVITIS. ECZEMATOUS KERATITIS. TUBERCULAR KERATITIS. A prevalent corneal affection, usually an extension of the same form of conjunctivitis, characterized by the appearance of small, single or multiple nodular lesions on some portion of the cornea, the limbic area being the most frequently involved.

As a supplement to the matter on p. 3433, Vol. V of this *Encyclopedia,* it may be said here that as early as 1869 Iwanoff correctly recognized a protuberant cellular infiltration of the epithelial layer resting on Bowman's membrane. These nodules are readily identified by their clinical features alone. At the beginning, they are observed as small, translucent projections, restricted to the epithelial layer and resting on Bowman's membrane. Later they break down, become

yellowish in color and small ulcers are formed. Ordinarily the ulcer thus formed is shallow and, as there is little loss of substance, the remaining opacity is faint. In other cases the disease displays a migratory tendency and extends farther into the cornea, either along its surface or, in severe cases, into its depth, when the breaking down and destruction is so extensive as to eventuate in perforation. In these severe cases, exudate from the onset is discernible in the deep layers of the cornea as a diffused infiltration, the overlying epithelium being stippled. The surface extension of the ulceration, in some cases, assumes serpentiform characteristics and displays clinical features akin to fascicular keratitis. The condition occasionally assumes the clinical aspect of a pannus (pannus eczematosus), when new formation of tissue and blood vessels develop in any portion of the cornea, differing, in this respect, from trachomatous pannus which has a predilection for the upper part of the cornea, is thicker, more vascular and apt to be permanent, whilst that of eczematous origin usually disappears without any remaining trace.

Instead of being vesicular, as the name phlyctenule implies, the nodules are solid formations, consisting chiefly of an accumulation of leucocytes.

In rare instances the nodules have been found to involve Bowman's membrane. See the figures, p. 3435, Vol. V of this *Encyclopedia*.

With reference to *atypical cases*, Parsons (*Pathology of the Eye*) says that "Baas found nodules below Bowman's membrane in a case of prolonged scrofulous keratitis with superficial opacities. The nodules consisted of new-formed fibrous tissue, with flattened nuclei lying parallel to the surface; they involved either the whole or only the deeper part of Bowman's membrane, having either a broad basis of attachment to the substantia propria or a narrow pedicle. These nodules were obviously late scars, and but little stress can be laid upon the observations, especially as the patient was also syphilitic, and had specific choroiditis. So far as they go they tend to show that the phlyctenules are endogenous, the aggregations of leucocytes lying originally below Bowman's membrane." He also states that "the cases reported by Gruber and Hertel are even more open to question. The first was in a child aged two and a half months, and was a deep, purulent ulcer; the second was in a shrinking eye with leucoma adherens. In the latter the changes were also beneath Bowman's membrane, which was fibrillar and broken through in places. The site of the phlyctenules was marked by dense infiltration, the epithelium being lifted up and partially destroyed. There were several small subepithelial nodules in the conjunctiva. Augstein reported the case of a child

with pannus scrofulosus and multiple infiltrates in the cornea. There was infiltration and formation of new connective tissue in the superficial lamellæ. Bowman's membrane was to a large extent destroyed. Vessels were found both in the superficial layers and deep in the cornea. Seo and Yamaguchi, in a case of fascicular keratitis and pannus scrofulosus found small deposits of fibrous tissue and connective-tissue cells lying under Bowman's membrane, which was eroded, in the otherwise normal parts of the cornea. The most superficial lamellæ were either intact or somewhat thinned. These were doubtless the sites of former phlyctenules, and confirm Baas' results. Very little stress can be laid upon such cases as these, and we must await the opportunity of examining an early uncomplicated case before the pathological anatomy of phlyctenular keratitis can be settled.''

Gifford, in 1886, ascertained the consistent presence of staphylococci (aureus and albus) in the conjunctival secretions or pustules surrounding the eye, in cases of keratitis phlyctenularis. In twenty-eight cases these bacteria were found in twenty-six. With reference to the bacteriology of this disease Parsons thinks that most late observers have found staphylococci, which may be accessory, though not causal, but are more likely to be mere contaminations.

Phlyctenular keratitis is most commonly observed in children, between the ages of two and twelve years. It is rare before the first year of life, but occasionally occurs after puberty. Those afflicted with this form of keratitis frequently suffer from rhinitis, eczema of face and scalp, hypertrophied tonsils and adenoids, and glandular enlargement. Many of these children manifest signs of the exudative diathesis of Czerny.

The observations of Hayashi, resulting from a study of the pathologic anatomy of five corneal and three conjunctival phlyctenulæ, showed that the most pronounced early changes are to be found in the most superficial layers of the substantia propria, and that they are present when the epithelium and Bowman's membrane are yet unaffected. These layers, however, do not long escape involvement; the epithelium is soon raised from Bowman's membrane and leucocytes (occasionally a few lymphocytes) and fixed corneal cells make their appearance between those layers of the corneal parenchyma nearest the lesion.

Symptoms. Photophobia, frequently intense, and blepharospasm, not commensurate with the corneal involvement, and profuse lacrimation are characteristic of this affection.

Etiology. Considerable diversity of opinion exists regarding the etiology of phlyctenular keratitis. Late observations leave little to

support the ectogenous bacterial theory and have added most convincing proof of its endogenous origin, i. e., that the lesions are produced by the action of the toxins of tubercle bacilli or bacillary fragments.

Straub's investigations have proved that scrofulous children have practically the same specific weight of water; that of the normal child being greater. These observations definitely prove that there is a consistent variation in their bone densities, the normal child having a greater deposit of lime salts.

Bruns is inclined to discard all other etiologic theories of phlyctenular ophthalmia in favor of a neuropathic phenomenon which he believes is induced by autointoxication. He offers the following observations as a logical basis for his views: "Autointoxication, originating in the great majority of cases, as the effective treatment clearly shows, in derangement of the gastro-intestinal functions; not all persons being equally liable to these morbid processes, but much more particularly those in whom we recognize clinically the scrofulous, lymphatic or exudative diathesis; such persons being especially liable to tuberculosis and to other infectious diseases, which in their turn further depress the metabolic and catabolic processes, the functions of digestion, assimilation, secretion and excretion, and these intensify and perpetuate the state of autointoxication."

Colombo (*Klin. Monatsbl. f. Augen.*, Vol. L., pt. II, p. 610, 1912) also believes that the causal factor in phlyctenular ophthalmia is to be found in auto-intoxication when the poisons, originating in the intestinal tract, reach a state of concentration sufficiently high to impair the bodily resistive forces. In a series of 115 cases, indican was present in variable amounts in 82 6/10 per cent., and in the remaining 17 4/10 per cent. he found traces or none at all.

Malnutrition, in this, as in many other diseases, surely has a predisposing influence by lowering the body resistance, but, since few ill-nourished children become affected, it can not be regarded as more than a predisposing factor.

Burnett, in a broad sense, holds the same opinion as Bruns, who rejects the tubercular theory on the ground that since from 10 to 12 per cent. gave negative von Pirquet reactions, the theory had failed, a contention which is not acceptable, as every clinician recognizes the fact that there are many persons who are unmistakably tubercular or luetic, who do not react to the von Pirquet test for tuberculosis or give a positive Wassermann reaction for lues.

Derby and Ayers have contributed valuable evidence, to establish the relation between recurrent superficial keratitis and tuberculosis.

The ages of the patients averaged nine and a half years; family history of tuberculosis was positive in twenty-five per cent.; temperature elevated in 48 per cent.; positive signs of tuberculosis elsewhere in the body in 44 per cent.; positive cutaneous reaction in 92 per cent. In commenting upon the cutaneous test, these investigators regard a negative reaction of greater diagnostic value than a positive one, since the reaction in so many individuals is positive.

In fifty-eight children, suffering from phlyctenular ophthalmia, Weekers obtained a positive von Pirquet reaction in fifty-one; in the remaining seven the reaction was either doubtful or negative. In 123 adults having phlyctenular disease, Cohen found incipient tuberculosis in 12 per cent., florid phthisis in three per cent. and in 52 per cent. there was a family history, or a suggestive history, of tuberculosis. These statistics were made prior to the discovery of the von Pirquet test, which explains the low percentages obtained by the earlier investigators.

Verhoeff believes the phlyctenule to be an anaphylactic phenomenon. His theory is that the tissues become sensitized by previous infection so that a slight reinoculation is sufficient to cause a reaction.

Davis and Vaughn (*Ophth. Record,* Vol. XXI, No. 9, Sept., 1912), studied forty cases (using the von Pirquet test diagnostically) ranging in age from seven months to forty-seven years (average age, about eleven years). They observed the following: twenty-eight (70 per cent.) gave a positive reaction, while in twelve (30 per cent.), the test was negative; an elevated temperature occurred in nineteen cases (47.50 per cent.) and reduced in three (7.50 per cent.) and unaffected in eighteen (45 per cent.). There was a focal reaction in the eyes of three patients. They say that whether the phlyctenule itself, which may be considered a ''pseudo-tubercle,'' is due to tubercle bacilli, or to the toxins of this bacillus, or to another cause, is yet to be determined. In the meantime, judging from their limited use of tuberculin in these cases, they conclude that tuberculin should be used in every case, both as a diagnostic and as a therapeutic measure, and that general hygienic and diatetic measures should be carried out just as in any other disease in which the system is in a run-down condition.

Stephenson (*British Med. Jour.,* April 16, 1910) believes that while nobody asserts that the phlyctenule itself is of tuberculous histologic structure, or that it contains tubercle bacilli, nevertheless it is most ordinarily held that the characteristic lesion occurs only in those who are subjects of tuberculosis, latent or otherwise.

Walter (*Jour. A. M. A.,* Vol. LXI, No. 13, Sept. 27, 1913), draws our attention to two possibilities that may explain the negative finding of

tubercle bacilli in these lesions: (a) imperfection in staining technic; (b) their quick destruction after infection. He adds that Wegelin, in a study of (supposed) healed calcareous tuberculous lesions, was able to demonstrate tubercle bacilli of low virulence by a special process of staining, namely, the alkaline hypochlorite method, so that it remains to be seen whether one might not more often demonstrate tubercle bacilli in these lesions by employing more appropriate methods of staining. The conclusion, he thinks, is also justified by this and by the work of Rabinowitsch and Schmitz that the tubercle bacilli in most of the so-called healed tuberculous lesions, even the calcareous or encapsulated ones, are still viable.

Diagnostically it is probably preferable in this disease to first apply the von Pirquet test; if negative, the intradermal method may then be used, the latter being more definite in its results. It is generally conceded that a local, focal reaction must be obtained for a decisive diagnosis.

Treatment. Sufferers from phlyctenular keratitis should, when expedient, be placed in the best possible hygienic surroundings, fresh air and a nourishing, bland diet being necessary requisites in the management of these cases. Fats, sugars, acids, tea and coffee should be withdrawn from the dietary. Cryptic or hypertrophied tonsils and adenoids should be removed. Nasal catarrh, so commonly associated with this disease, responds readily to warm irrigations of Dobell's solution, followed by applications of one of the mercurial ointments. Locally, no remedy is more efficacious than yellow oxide of mercury, which should be applied once or twice daily in strengths of from two to five per cent. Holocain is a valuable remedy for the control of pain, while atropin acts efficaciously in combating complications of the disease.

Bruns regards the internal administration of bichlorid as almost a specific for this affection. Gradle has used antistaphylococcic vaccine with satisfactory results, when staphylococci were present in the secretions. Coleman has produced cures by *x*-ray treatment in cases which resisted all other therapy.

When tuberculin is exhibited therapeutically, either old tuberculin (T. R.) or the emulsion (T. E.) administered hypodermically, preferably in small doses, every three to eight days. Wright's principle, based fundamentally on the stimulation of antibody formation, suggests the propriety of infinitesimal doses. This reasoning, and the probable harmful effect of physiologic doses, has lead a majority of clinicians to abandon the method of von Hippel—that of rapidly increasing the dosage, governed by the temperature.—(J. D. L.)

See, also, **Calmette's reaction,** on p. 1361, Vol. II of this *Encyclopedia;* as well as **Bacteriology**; **Seropathy**; and **Conjunctivitis, Phlyctenular.**

Keratitis profunda. CENTRAL INFILTRATION OF THE CORNEA. CENTRAL PARENCHYMATOUS KERATITIS. DEEP KERATITIS. CIRCUMSCRIBED KERATITIS. A variety of keratitis parenchymatosa to which Arlt has assigned the name keratitis profunda. It is an affection confined to the middle and deep layers of the substantia propria, characterized by the appearance of a diffuse and quite uniformly grayish infiltration, usually situated at the center of the cornea, where it is seen as a cone or disc-like form. When examined with the corneal microscope or loupe, the opacity is seen to be composed of numerous discrete maculæ and interlacing striæ, with an ill-defined border. The disease is one of adult life, not chronic in its nature and disappearing without ulceration intervening. Reis observed, in an otherwise healthy girl, a well-defined case, associated with uveitis, and, Krauss, one without involvement of the uveal tract, in a healthy girl of 12 years. The inflammatory symptoms are usually mild, yet, occasionally, the irritative symptoms are very pronounced. In the simple forms, the opacification is temporary, but when the process is well-marked, permanent central opacification may result. The instillation of fluorescein produces a deep stain of the cornea.

Etiology. The causes of keratitis profunda are quite obscure, but it usually develops subsequent to injuries, especially when the resisting powers of the cornea are impaired as the result of some general disease. Straub believes that a more general application of the tuberculin test would prove tuberculosis to be the cause in many cases. Straub, Fuchs and Krauss regard the corneal affection as primary, as they have been unable to find any clinical evidence of involvement of the ciliary body. Auto-intoxication, lues, gout and malaria have, in several instances, been determined as predisposing causes.

Treatment. Attention directed to the patient's general health is the first requisite. Yellow oxide of mercury and massage have been employed with quite satisfactory results. Atropin should be used when iritic involvement exists. Dark glasses or the application of bandages are, at times beneficial adjuvants, but hot compresses and dionin have rendered the best services as local measures.—(J. D. L.)

Black (*Ophthalmic Year-Book*, p. 162, 1909) has reported the recurrence of the disease in a woman 58 years of age, who had a similar attack twelve years before. At that time the cornea had the appearance of ground-glass, but cleared after two months. The treatment then used was atropin, heat, galvanism, and iodide of potassium. The

present attack had lasted two and a half months, and still the roughening of the cornea, deep infiltration and inflammatory signs persist.

Keratitis punctata profunda. See **Keratitis, Syphilitic punctate.**

Keratitis punctata subepithelialis. Harry Gradle (*Archives of Ophthal.*, Sept. 1911), believes that he has observed five cases of corneal disease to which this name might properly be applied. They do not, he says, correspond to any of the well known divisions of keratitis. The disease occurs in women, usually past the age of thirty. The inflammation is produced in the form of isolated, grayish areas that look infiltrated, lying under Bowman's membrane, with an intact superficial epithelium and characterized by subjective injection and photophobia. It occurs at varying intervals in either eye and is self-limited. It does not seem to be affected by any known form of treatment.

Keratitis punctata vera (Mauthner). See **Keratitis, Syphilitic punctate.**

Keratitis, Punctate. Serous iritis. Aquo-capsulitis. Serous irido-cyclitis. Descemetitis. In addition to the matter to be found on p. 3845, Vol. V, of this *Encyclopedia* the reader is referred to the **Iritis** captions, as well as to **Iritis, Serous,** and to the figure in the text of this section. To this material it may be added that punctate keratitis really belongs to the category of diseases of the ciliary body, since Treacher Collins found that the symptoms are due essentially to pathologic changes in that organ.

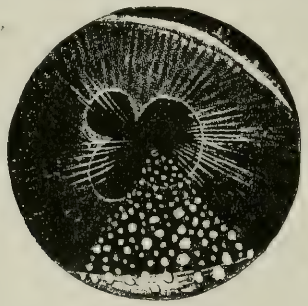
Symptoms. The corneoscleral region shows a delicate, rose-colored injection. The anterior chamber is of normal or increased depth. The pupil is of normal size or slightly dilated. The tension is slightly increased at first, but diminishes later. The tendency to the formation of posterior synechiæ is not so marked as in iritis. The iris reacts slowly to light. Pain is rarely a prominent symptom. Exudation into the anterior chamber is moderate in amount, causing the aqueous and cornea to become cloudy. A deposit of opaque dots, often arranged in triangular form with the base downward, appears on the posterior elastic lamina of the cornea. The visual field may be contracted. A central scotoma may be present.

Serous cyclitis may exist alone, but generally it is found associated with choroiditis, interstitial keratitis, or scleritis.

Etiology. The disease occurs chiefly in ill-nourished, anemic young persons, particularly in women suffering from uterine diseases. According to Horner, it is more frequent in women than in men in the proportion of 10 to 3. Some cases are undoubtedly due to syphilis, either early or as a late manifestation, while others have been attrib-

uted to rheumatism, gout, eyestrain, or to trauma. A serious form of this affection is caused by sympathetic ophthalmitis.

Pathology. The investigations of Nicati, in 1891, showed in rabbits the existence of glands in the ciliary body for the secretion of aqueous humor. Treacher Collins, working about the same time, demonstrated by bleached sections the existence of similar glands in the human eye. Serous cyclitis is a catarrhal inflammation of these ciliary glands. Hyperemia is followed by increased secretion and deepening of the anterior chamber. The aqueous humor becomes more albuminous than normal. A few leucocytes, together with some pigmented epithelial cells thrown off from the surfaces of the glands, and shreds of fibrin, are present. These solid elements drop to the bottom of the anterior chamber and form the dots of so-called "keratitis punctata." Leu-



Keratitis Punctata and Small Hypopion in Irido-cyclitis Traumatica. Healed cicatrix of cornea.

cocytes collect in the ligamentum pectinatum and hinder the egress of aqueous, thus causing increased tension. The turbidity of the aqueous humor causes the iris to lose its lustrous appearance. Severe cases may end in involvement of the vitreous humor with shrinking of the globe and development of cataract.

Prognosis. Except as a manifestation of sympathetic ophthalmitis, serous cyclitis offers a favorable prognosis. Adhesions do not often form between the iris and lens-capsule, but sometimes permanent opacities are left in the cornea and vitreous humor. The disease runs a slow course. When associated with marked fundus changes it may lead to blindness.

Treatment. The internal use of mercury and potassium iodid is of value in these cases. Mercury used by inunction or hypodermically is an efficient remedy. If the patient is anemic, tonics are to be employed. In the cases due to gout and rheumatism, Turkish baths, diuretics, tonics, and exercise, together with appropriate diet, are

to be employed. As regards local treatment, the use of weak solutions of atropin is of value. If the tension is increased, paracentesis of the anterior chamber should be done, followed by the use of pilocarpin, arecolin, or weak eserin solutions. The presence of vitreous opacities will call for the vigorous use of mercury and diaphoretics internally. Use of the eyes for near work should be prohibited. As a rule, the patient should not be kept in a dark-room. The management of those cases which are due to sympathetic ophthalmitis will be described elsewhere.—(J. M. B.) See, also, **Sympathetic ophthalmia.**

Keratitis, Purulent. This term is occasionally applied to progressive or serpent ulcer of the cornea, a subject fully treated on p. 3447, Vol. V, of this *Encyclopedia.* To the material there collected may be added the experience of H. M. Traquair (*Ophthal. Review,* Jan., 1911) in the treatment of the disease by zinc iontophoresis (q. v.). The current passes through a rheostat, current reverser and milliampere meter to a pair of terminals, which are connected by flexible rheophores to the electrodes. There is also a small clock to time the application. The indifferent electrode consists of a small piece of zinc which may be put into a basin of salt solution in which the patient places one hand, or may be applied to any convenient skin surface, wrapped in lint moistened in salt solution. The active or corneal electrode consists of a rod of pure zinc bent at an angle of about 130° and shaped at one end so as to fit into a small celluloid cap, which has an orifice at its distal end of about 1.5 mm. diameter. The other end of the zinc rod screws into a handle consisting of a copper conductor encased in celluloid to the center of which the rheophore is attached. The celluloid cap is filled with cotton wool which projects slightly from its distal orifice. It is then moistened with a 0.5 per cent. solution of zinc sulphate and fitted on to the zinc rod, the end of which is kept polished. A second rod of zinc, conveniently bent and sharpened, may be screwed into the other end of the handle. 1. Although special apparatus is required, the technic is very simple. 2. An electrode 1.5 mm. in diameter and shaped like a thermocautery is very convenient. With this size a dose of 1.5 minutes is enough. 3. Care should be taken to treat thoroughly every portion of the advancing edge of the ulcer. 4. The difficult parts to treat are those where the undermining is very deep and the overhanging tissue thick and tough, and the infected foci, sometimes seen, which project like buds deeply into the cornea. These spots should be scraped with the zinc point with a dose not above 0.5 ma. for 0.5 minutes. 5. Generally speaking the smallest efficient dose should always be used. 6. When the process is not checked it is

because the causal organisms have not been properly got at, not because they have proved resistant. 7. Pain may occur, either immediately following the application or some days afterwards, in this case due to iritis. Eucaine ointment for the former and atropin for the latter have proved successful remedies. Only in exceptional cases is the treatment followed by severe pain. 8. The method is certainly efficient for mild and moderately severe ulcers. 9. More experience is required before it can be said that zinc iontophoresis is an unfailing remedy in severe cases. It has certainly produced results as good as, or better than might have been expected from the cautery in those severe cases in which it has been used. With or without paracentesis it would appear to be suitable for those advanced cases in which the condition of the cornea renders cauterization inadvisable. 10. The eye may remain red for a longer time than usual after the ulcer is healed, but this circumstance does not indicate any serious condition, and may be neglected. 11. The healthy corneal tissue adjoining the ulcer is not destroyed as it is by the cautery, with the result that thinner and less extensive scars are produced. 12. As far as can be judged from the evidence to hand, the average vision obtained is superior to that following cauterization.

Keratitis, Pustular. A synonym of phlyctenular keratitis.

Keratitis pustuliformis profunda. Fuchs gives an account of this rare form of corneal disease in Vol. 90, p. 13 of Graefe's *Archiv für Ophthalmol.*, 1915. He reports 15 cases with the anatomical examinations of 4 eyes. The disease is characterized by yellow infiltrations of varying size and shape in the deep layers of the cornea in the pupillary area. They may be as small as the head of a pin and may be arranged in a straight or circular line. The yellow spots generally are surrounded by a faint-gray focus which without sharp borders passes into the fine, diffuse opacity, extending over the whole cornea and consisting, under the loupe, of minute gray dots. The surface of the cornea is always dull and anesthetic, but there is no defect of substance. The corneal affection is always associated with a severe iritis. The iris is swollen and discolored and often covered by pus, and there are always synechiæ and membranous exudates in the pupil. Above all the iritis is characterized by a large hypopyon which, if evacuated by puncture, is rapidly replaced. In most cases it is free from germs. The course of the disease is always chronic. The yellow spots may grow larger, or new spots may arise, but never such an extensive yellow discoloration of the cornea occurs as in serpent ulcer. The prognosis is better, however, since the yellow spots never develop into ulcers. Their ultimate fate is a conversion into permanent, gray,

deeply-situated and often vascularized opacities. This takes place in from one to several months. Vision is permanently impaired by the opacities and the sequels of iritis, synechiæ and pupillary membranes. In the most severe cases a moderate degree of atrophy of the eyeball with blindness or mere perception of light ensues. The disease generally affects only one eye, mostly in senile subjects; more than half were over fifty. With one exception it occurred in men.

The histories apparently gave no clue to the etiology, but an injury could be excluded with certainty, and the clinical and anatomical findings did not point to an ectogenous infection.

Fuchs concludes from his observations, that the disease commences with an apparently spontaneous iritis of unknown cause, which affects the posterior layers of the cornea by secretion of toxic substances into the aqueous. Four out of the fifteen cases had lues, which may be thought of most as an etiological factor. The anatomical examination revealed no evidence of tuberculosis. Fuchs applied the name pustuliformis, because the yellow infiltrations look like pustules, but, as the anatomical examination disclosed, are not pustules.

Keratitis, Pyorrheal. See **Keratitis, Dental.**

Keratitis, Reaper's. See **Keratitis, Harvester's.**

Keratitis, Recurrent. Relapsing traumatic keratitis. Recurrent erosion of the cornea. See p. 3438, and p. 3364, Vol. V, of this *Encyclopedia.*

Keratitis, Relapsing traumatic. A synonym of relapsing erosion of the cornea. See p. 3438, Vol. V, of this *Encyclopedia.*

Keratitis, Reticular. Reticulate keratitis. Generally, though not invariably, employed by writers as a synonym of lattice-shaped keratitis; sometimes confused with *striate* keratitis.

Keratitis, Rheumatic. See **Iritis.**

Keratitis, Riband-like. Ribbon-like keratitis. See p. 877, Vol II, and p. 3440, Vol. V, of this *Encyclopedia.*

Keratitis, Ribbon. Ribbon-shaped keratitis. See p. 877, Vol. II, and p. 3440, Vol. V, of this *Encyclopedia.*

Keratitis rosacea. Acne of the cornea. In addition to the information to be found on p. 75, Vol. I, and on p. 3331, Vol. V, of this *Encyclopedia,* attention is further directed to the essay of Burton Chance (*N. Y. Med. Journ.,* Feb. 3, 1912) describing a case of corneal acne in a man forty-two years of age. The author reports that he had his worst attack when he was twenty-six years old. He had styes at first and then photophobia and lacrimation, and his sight rapidly became clouded so that by the end of two weeks he could not see. The visual symptoms lasted for about four months, and by this time

the skin had become pale and smooth again. After a week or two the irritative symptoms subsided so that he was able to see a little. On recovery he had useful sight. For a number of years subsequent to this he had many corneal attacks, with "styes," and "ulcers of the lids." When seen by Chance the case exhibited extensive corneal erosions which were greater in the right than in the left eye. These occupied the area of the fissures, although the peripheral portions were studded with minute areas of infiltrate beneath the epithelium. There was distinct vascularity, the vessels being tortuous and looped. The whole of the cornea was edematous and there was marked photophobia. The lids were boggy, the glands were congested, their ducts obstructed, out of the mouths of which the contents could be expressed. Atropin and zinc lotions were ordered and a saturated solution of sodium salicylate with cathartic pills (and a rice diet) were prescribed for the maintenance of gastro-intestinal antisepsis. After forty-eight hours there was less edema of the corneas and the peripheral portions seemed to be clearer, while the photophobia was distinctly reduced. By this time the eroded areas were distinctly necrotic, the patches had become quite wide on each cornea, and the remaining portions were very uneven. Chance touched the denuded surfaces with carbolic acid, and hot compresses were applied steadily, while a solution containing holocain (which the writer regards of decided value in this disease) was instilled every three hours. After two days there was a marked regression, though the globes were excessively vascularized. One week later both the skin and the eyes were less affected, and for the first time it was possible to ascertain the visual acuity; in the right it was $5/25$; in the left, $5/30$. Finally, the general symptoms subsided to a remarkable degree. The surface of the skin was smooth, without thickening and prominence of the follicles. The rosy hue remained because of the chronically dilated venules. The lids were thin and healthy. There was no photophobia nor tarsal cramp. The globes were white, the corneas free from vascularity, the obliterated vessels showing their branchings by transmitted light. The left corneal surface was quite smooth, the right uneven because of the wider distribution of the deposits. No clear fundus view was possible. The man had always been of steady habits. He had been vigorous in health, being quite athletic. Almost anything agreed with him and his appetite was always good. He had been pure in his personal life. He was married at twenty-five years of age, but had only one child, a son of fourteen years. Since marriage the disease of his eyes had been worse than before. He had never noticed any causal relation between the state of his general health and the onset or progress of the

skin disease, nor of the ocular lesions. He maintained the idea that the onset of the disease followed his working among oily yarns and in the use of theatrical grease paint.

Keratitis, Sclero-. See **Keratitis, Sclerosing.**

Keratitis, Sclerosing. Sclero-keratitis. This condition has its origin in, and therefore appears secondary to, scleritis of which it may clinically be considered as a symptom. It attacks the cornea in the shape of a triangular opacification, the base of which corresponds to a pre-existing nodule of scleritis, with the thinner apex directed toward the summit of the cornea, where it fades away in the normal transparent cornea. Sometimes a clear area is interposed between the lesion and the sclero-corneal margin and occasionally the opacification is located at the center of the cornea. The opacification is white and dense, attacking the deeper layers if a nodule in scleritis is adjacent to the corneal limbus. The corneal lesion is usually single, often double, and occasionally multiple, and, therefore, not unlike the normal sclera in appearance, for which reason von Graefe applied the name of sclerosing keratitis. While the infiltrate is usually sector-like, it often departs from any regular triangular outline; in some cases rounded or irregular maculæ appear, which are isolated from the principal opacity. At the beginning the opacities, which involve the deeper layers of the cornea, are gray or grayish-white. The saturation becomes more and more marked until the implicated area is rendered completely opaque; that is to say, when the process has subsided, the molested area becomes permanently dense and bluish-white at the base, due to the deposition of fibrous tissue, and, in appearance, is almost identical with the scleral lesion.

There are cases in which recurrences are frequent and the sclerosing process progresses until the entire cornea, with the exception of a small portion at the center, is rendered opaque. Tendering carefully examined a case of so-called *corneal sclerosis* which, in the beginning, was thought to be one of atypical parenchymatous keratitis. The cornea was densely cloudy and in the central portion fatty degeneration occurred. The conjunctiva was free from irritation. Regressive metamorphosis, probably the result of endarteritis obliterans, was considered as the possible cause.

During the activity of the condition the cornea is frequently stippled at the site of the sclerosing process, yet there is no depression of the cornea. Vascularization may never appear, but when it does accompany sclerosing keratitis, it is deep, indicating that the deeper layers of the cornea participate in the sclerosing process, or that iritis

has complicated the disease and is responsible for the inflammatory symptoms.

The clinical picture of the *rheumatic sclero-keratitis* of Pfalz is characterized by the sudden appearance of pericorneal injection, photophobia, lacrimation, sensitiveness to pressure and a gradual extension of the inflammatory process through the periphery of the cornea, where there is later seen delicate opacities in the deep layers.

The opacities are of short duration as are the other symptoms; recovery taking place in three or four days (when appropriately treated) otherwise its duration is about three weeks, except in those cases which are of a chronic (relapsing) nature and complicated by iritis. Young female subjects are the ones most often afflicted. It is a disease which commonly affects both eyes.

Etiology. The cause of sclerosing keratitis is usually obscure and must be sought in some general disease, such as chlorosis, hereditary lues, tuberculosis and, in older patients, gout and arthritis.

Verhoeff, by injecting dead tubercle bacilli into the vitreous body, or anterior chamber, of a rabbit, observed, after about three months, pathological manifestations closely allied to those clinically present in sclero-keratitis in man. These findings add additional support to the theory that the infection in cases of tuberculous keratitis is derived from the aqueous humor and reaches the cornea through the mesh of the ligamentum pectinatum.

Treatment. If the disease can be traced to the fundamental cause, something may be accomplished by measures directed thereto. In cases which are the result of rheumatism, Pfalz and others have found in the action of salicylate of sodium a most efficient remedy, the effect being quite pathognomonic. When salicylate of sodium is not well tolerated, aspirin was administered.

In cases where tuberculosis appears to be the underlying cause, tuberculin may exert a beneficial influence. Locally, massage and yellow oxide of mercury have been recommended but hot compresses and dionin are probably the most efficacious local means of combating this affection.—(J. D. L.)

Keratitis, Scrofulous. See **Keratitis, Phlyctenular.**

Keratitis, Sequestrating cicatricial. ULCUS ATHEROMATOSUM CORNEÆ. Under this title Fuchs has described the development of ulcerative processes in old corneal scars, in which calcareous and hyaline metamorphoses have occurred. An example of this process is the alterations at the apex of a corneal staphyloma following injury. The necrosis thus induced may extend through the whole thickness of the cornea and the resulting perforation end in panophthalmitis.

Keratitis, Snail's track. Frenular keratitis. This peculiar term is applied to that form of eczematous disease of the cornea in which a line of phlyctenules forms, the first one at the limbus corneæ, while others appear in succession towards the pupillary area. Sometimes these discrete phlyctenules form a curved instead of a straight track, while the vascular supply is a well-marked leash of blood vessels, as in fascicular keratitis. On healing, the line of phlyctenular ulcers forms an opaque streak called the *scrofulous band.*

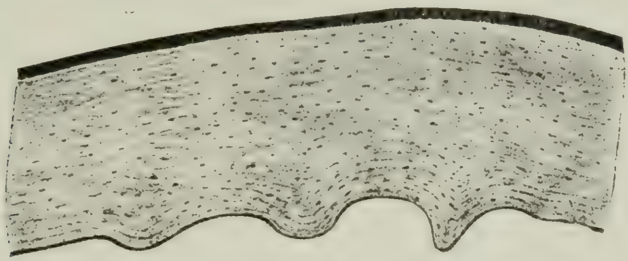
Keratitis, Specific. See **Keratitis, Parenchymatous.**

Keratitis, Star-shaped. Stellate or dendritic keratitis.

Keratitis stellata. A synonym of keratitis dendritica.

Keratitis, Striate. See **Keratitis, Striped.**

Keratitis, Striped. Striate keratitis. Keratitis striata. Occasionally, with doubtful propriety, called *reticular or reticulate keratitis.*



Section of the Cornea in Striate Keratitis. (Hess-Ball.)

The folding of the posterior layers of the cornea is shown in the lower part of the figure.

The name *striped* keratitis has been applied to two different conditions which occasionally occur after cataract extraction or trauma. In both there is an opacity which is located in the posterior layers of the cornea. In true striped keratitis there is noticed, at the first or second dressing after cataract extraction, the presence of fine, straight lines of opacity, one-half to one millimetre in width, which converge toward the wound. In some cases the lines cross, forming panel figures. Several theories have been advanced to account for the phenomenon. Beck and Recklinghausen attributed it to dilation of lymph-spaces; Alt, to infiltration of large nerve-canals; but the view now generally accepted is that of Carl Hess and others, viz.: that this peculiar striate opacity depends on the folding of Descemet's membrane, resulting either from the shrinking of the cornea by cicatrization or from unequal swelling of the corneal tissue by infiltration. However produced, the condition generally disappears within a few

days. Striped keratitis is occasionally seen after corneal injuries or inflammation.

The other type of opacity, also common after cataract extraction, is in the form of permanent white opacities, which are due to the action of chemicals. It is often seen in the practice of those surgeons who irrigate the anterior chamber with solutions of bichlorid of mercury. These opaque spots materially reduce vision. —(J. M. B.) See, also, **Cataract, Senile,** and p. 3472, Vol. V, of this *Encyclopedia.*

A. C. Hudson (*Ophthal. Review,* Nov., 1908) has described an anomalous form of striate opacity not associated with cataract extrac-

Striped Keratitis after Cataract Extraction. (Würdemann.)

tion. The patient was 56 years of age, and in good health except for a recent hemiplegic attack. The striate keratitis was noticed in each eye; the vision in the right was $^6/_9$, that of the left being $^6/_6$.

There had been gradually increasing failure of sight both for distant and near vision for the last five years.

The central region of each cornea was occupied by a mycelium-like striation, whose branches anastomosed, forming a fine network. The individual lines varied in thickness, and were set in different planes in the corneal tissue, but are on the whole nearer the anterior than the posterior surface. In addition to this there was, in the central area of the left cornea, an exceedingly fine striation, also present in the right, though much less marked. The vision in both eyes when last tested was $^6/_{36}$, and the corneal sensation unaffected.

Keratitis, Strumous. See **Keratitis, Phlyctenular.**

Keratitis subepithelialis centralis. See **Keratitis, Superficial punctate.**

Keratitis, Subepithelial punctate. See **Keratitis, Superficial punctate.**

Keratitis superficialis. A term applied to any form of the disease that is mostly confined to the anterior epithelial layer of the cornea.

Keratitis, Superficial punctate (Fuchs). KERATITIS SUBEPITHELIALIS CENTRALIS (ADLER). KERATITIS MACULOSA (REUSS). KERATITIS SUPER-

FICIALIS. NODULI CORNEÆ. A form of superficial keratitis, first described by Fuchs (1889), allied to herpes febrilis corneæ, but differing from the latter disease in that there is no formation of vesicles. The onset is usually characterized by the appearance of pronounced inflammatory symptoms, similar to those observed in acute conjunctivitis. In some cases the inflammatory symptoms are slight or entirely absent. The dots appear either simultaneously with the inflammatory symptoms, or their development may be delayed for days or several weeks. The individual spots are not visible to the unaided eye. With the assistance of focal illumination and the loupe or corneal microscope, however, these maculæ are revealed as round, faintly-gray, minute lesions, most numerous in the central portion of the cornea, varying in number from 10 to 100 or more, and situated in the most superficial corneal layers. The grouping of the dots is as variable as their number. The epithelium is elevated at the points corresponding to the maculæ. Herbert, however, has noted that the epithelial layer is sometimes depressed over the dots. The lesions remain for some months, gradually disappearing without ulceration, except in rare instances. Following the instillation of fluorescein and under magnification, the cornea is seen to be studded with deeply-stained (green) punctate spots.

In addition to an acute catarrhal conjunctivitis, the condition has been found as an accompaniment of ophthalmia scrofulosa, influenza, herpes corneæ, trachoma, ophthalmica electrica, corneal wounds, long continued bandaging, and after measles.

Trantas states that punctate keratitis, which may be epithelial, subepithelial, or deep, frequently occurs in leprosy. He regards the condition as truly leprous in character although the lepra bacilli are not always present in the lesions.

Herbert has described a form of this disease, prevalent in Bombay especially during the rainy season, which is usually monocular, and observed, as a rule, in young adults. From the epithelial scrapings he recovered an encapsulated bacillus. By Gram's method the bacilli are only slightly discolored, and it was not found possible to grow them on ordinary culture media.

The clinical picture of Wiener's case closely corresponds to the form of the affection that Herbert described. The round, grayish spots numbered about thirty, were centrally located and the epithelium was elevated at the corresponding points.

Gradle has directed attention to a variety of superficial keratitis which he terms subepithelial punctate keratitis, occurring in women after the age of thirty. He has observed five cases. The superficial

epithelium was intact and the isolated areas of infiltration were beneath Bowman's layer. The etiology was not determined and the disease was unaffected by any treatment.

Verhoeff, from a study of a typical case, regards the disease as one of neuropathic origin, the lesion probably being located in the ciliary ganglion. In rejecting the bacterial theory in favor of the neuropathic hypothesis, his deductions were influenced by the position of the lesions with reference to the area supplied by the posterior ciliary nerves, the character of the lesions, the decrease of intraocular tension and the fact that the disease is so frequently bilateral.

Bosser (*Wien. Klin. Rundschau,* Sept. 29, 1912) considers superficial punctate keratitis an expression of a nutritional anomaly brought about by disturbed menstrual function, affecting the secretions of the ovaries and producing irritability of the vaso-constrictor nerves. These phenomena are held responsible for an increased diapedesis between the corneal layers. Bosser believes his etiologic theory to be supported by the relationship between anesthesia of the cornea and diminution of intraocular tension.

With reference to the *treatment* of this disease, Wood (*Ophthalmic Therapeutics,* p. 743) says that G. Thomsen von Colditz for cases in the stages of repair applies the following twice a day: Hydrarg. oxidi flav., 0.30; Adeps. lanæ, Aquæ dest., āā 1.00; Petrolat. alb. ad, 10.00.

In cases of the disease *associated with chronic conjunctivitis* A. C. Rogers prescribes 1 to 3 drops, daily, of a 25 per cent. solution of the glycerite of tannin, and is guided by the reaction as to further dosage.

Instead of making actual contact with the point of the cautery, D. W. Greene, in superficial keratitis heats the metallic point to a cherry-red color and approaches it to within half a mm. of the corneal surface (or as near as possible without touching it) so as to destroy only the superficial débris that accumulates in these cases. This method produces effective asepsis without destroying any normal tissue, and without scarring results.—(J. D. L.)

Wm. L. Phillips (*Ann. of Ophth.*, January, 1913) has reported a case of superficial punctate keratitis that he regards as of neurotic origin. The symptoms began in the right eye with pain and foreign body sensations. The eye, however, was free from signs of inflammation. Examination by the ophthalmoscope and oblique illumination revealed ten to fifteen bluish-gray spots, surrounded by a light-gray halo, situated in the lower, right quadrant of the cornea. These spots were not dull, but were glistening like the rest of the cornea; and at the apex of each spot there was a dark-gray infiltration. Collectively, the spots resembled a pyramid situated between two radii drawn from the

center of the cornea temporally and directly downward. A few months after the right eye became affected the left was similarly involved in the corresponding quadrant, the spots being larger at the periphery; smaller as they approached the corneal center. This was due to the size of the halo rather than to the actual infiltration; and it was assumed that the drying effect of the air explained the absence of the halo about the central spots. When the lids were held apart the halo disappeared from all the spots, showing that it was caused by the moisture. No treatment was of service and no cause was assignable, but it was noticed that the disease increased in proportion to loss of sleep and nervous strain. Mental suggestion seemed to be of more value than anything else. The disease had continued for three years, but was then practically cured.

Keratitis, Superficial vascular. See **Keratitis, Vascular.**

Keratitis, Suppurative. See **Cornea, Ulcer of the**; in particular **Cornea, Serpent ulcer of the.**

Keratitis, Syphilitic. This term is generally employed as a synonym of parenchymatous keratitis, but it is occasionally used to indicate any corneal change in which it is suspected that lues has played the larger part.

Keratitis, Syphilitic punctate. KERATITIS PUNCTATA PROFUNDA (FUCHS). KERATITIS PUNCTATA VERA (MAUTHNER). This rare and late form of luetic, dotted keratitis is described by Fuchs as accompanying a specific irido-cyclitis. Isolated, gray specks appear in the middle and deep layers of the cornea, the disease being distinguished from keratitis punctata superficialis not only by the etiology but by the deeper situation of the deposits. The deep-lying dots are thought by some to be minute but true gummata. These uveal symptoms are not, as a rule, acute. The *treatment* of such cases is, of course, anti-syphilitic and it is generally successful.

Keratitis tenulosa. An obsolete name for phlyctenular keratitis.

Keratitis, Thread-like. See **Keratitis, Filamentary.**

Keratitis, Toxic. Any inflammation of the cornea set up by drugs or similar toxic agents. For example, Inouye has reported a case in which superficial, dotted corneal infiltrations and erosions were produced by antipyrin taken internally and rubbed on the facial skin, the lesions disappearing when the drug was discontinued. See, also, p. 523, Vol. I, of this *Encyclopedia.*

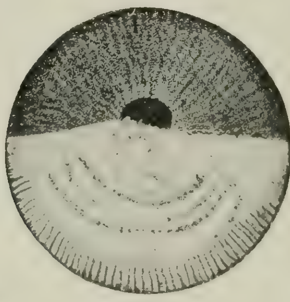
Kalaschnikof reported a keratitis after smearing the face with some red coloring matter.

The fumes of dimethylsulphate, to which chemists are exposed in the manufacture of products from methyl alcohol, have been found

to cause a violent and stubborn conjunctivitis and photophobia, with (probably) some involvement of the cornea—as Erdmann's experiments on rabbits with this agent have shown. He observed in them, in addition to the severe conjunctivitis, an edematous parenchymatous opacity, with blistering of the epithelium. Gradual resolution ensued, leaving delicate opacities in the corneal stroma.

Keratitis, Trachomatous. See **Keratitis, Vascular.**

Keratitis, Traumatic. Any form of keratitis arising from injury to the corneal tissues. This subject is freely discussed on p. 6276 *et seq.*, Vol. VIII, of this *Encyclopedia.* See, also, **Cornea, Relapsing erosion of the.**



Traumatic Keratitis from Burn by Hot Cinders. (Würdemann.)

Keratitis, Traumatic exfoliative. See **Keratitis, Erosion.**

Keratitis trophica. A synonym of band-shaped keratitis. The subject is discussed on p. 877, Vol. II, of this *Encyclopedia.*. See, also, the figures under **Keratitis, Band-shaped.**

Keratitis, Tubercular. CORNEAL TUBERCULOSIS. TUBERCLE OF THE CORNEA. It is well known that certain forms of phlyctenular and (but more rarely) parenchymatous keratitis are essentially tuberculous. This heading should, in fact, be taken as but one section of the literature of corneal tuberculosis, and be read in conjunction not only with p. 3494, Vol. V, of this *Encyclopedia*, but with **Tuberculosis of the eye**, and **Keratitis, Phlyctenular.**

Plainly marked tubercle of the cornea is, however, a rare affection, occurring as an extension of the same disease from some other part of the eye, usually the uveal tract or sclera. *Primary tuberculosis of the cornea,* is the rarest of all these forms of ocular tubercle; indeed, its occurrence is doubtful. The fact that the tissues of the uveal tract and the posterior layers of the cornea are associated embryologically argues in favor of the corneal condition being one of secondary involvement, manifesting itself in the form of an interstitial keratitis. A

number of cases of this type have been histologically studied by different investigators.

Bach has reported a case of primary tuberculosis in which the lesion —a nodule—occurred at the limbus.

Greeff observed the appearance of a primary tuberculous corneal ulceration in a patient suffering from tuberculosis, following a scratch of the cornea with the patient's finger nail.

Smith and Gibbs (*Ophthalmic Record,* Vol. XV, p. 582, Dec., 1906) believed they were reporting "the only case on record of true tuberculosis of the cornea." The lesion occurred in a female, age forty-four, otherwise in perfect health. The disease was of nine months' duration, affecting but one eye and presenting the following clinical symptoms: Slight pericorneal injection; cornea opaque, except a narrow, peri-corneal zone; normal lustre unaltered, T + 2. Through the transparent periphery, a white growth was visible in the anterior chamber, extending backward from the cornea and filling about two-thirds of the chamber. The eye was enucleated and a microscopical examination showed the mass to be a tubercle of the cornea.

Risley (*Annals of Ophthalmology,* Vol. XXII, p. 610) reported two cases, which he regarded as typical. The lesions appeared in the form of yellowish-white, tongue-like infiltrations, extending from the limbus toward the corneal center. The Von Pirquet tests were positive.

Clinically, the lesions are observed as: (a) an involvement of the superficial corneal tissues and eventuating in ulceration; (b) a form having the characteristics of sclerosing keratitis; (c) an interstitial type which is characterized by a number of dense foci, assuming the form of discrete opacities.

The opacities are generally modified miliary tubercles, which appear in their most characteristic and pronounced type when located near the surface of the cornea. In some cases, caseation is pronounced; in others, it is entirely absent.

It is extremely difficult to isolate tubercle bacilli in the corneal tissues, as these structures afford a poor culture medium. Nevertheless, several observers, among them Zimmermann and Schultze, have demonstrated the presence of the bacilli in corneal tubercles. It is only by inoculation experiments (except in the rarest instances), and the appearance of a tubercle nodule, that a true diagnosis can be determined. According to Parsons, histologic information rarely affords a decisive diagnosis.

The diagnostic application of the tuberculin test may be employed with general satisfactory results. When followed by a rise of temperature and a concurrent local reaction in the suspected eye, the result

is accepted as a positive indication of tuberculosis; but, if the local reaction is absent, even when the general response is present, the diagnostic inference is only one of probability.

Panas, Vassaux and Hansell have succeeded, by direct inoculations, in producing tubercles in the corneas of rabbits. Parsons was successful only when the anterior chamber, as well as the cornea, was inoculated. Stock saw severe tubercular lesions develop after intraocular injections of tubercle bacilli. Verhoeff found that the injection of dead tubercle bacilli into the anterior chamber or vitreous of a rabbit was followed, in about three months, by the appearance of sclerocorneal lesions analogous to those of tuberculous scleritis in man. These facts he accepts as confirmatory of his theory that tuberculous keratitis is due to an infection derived from the aqueous humor, where immune substances are wanting, reaching the cornea through the filtration angle. The chronic types of uveitis are, according to this author, probably best explained by metastasis from the aqueous humor; and not, necessarily, the result of direct blood metastases.

Verhoeff (*Journal A. M. A.*, Vol. LXIII, No. 1, July 4, 1914) found in the eye of a woman, aged thirty-six, who died of pulmonary tuberculosis, a corneal nodule. The right eye showed keratitis three years prior to death, which continued for a year before subsiding, reducing the vision to 20/100, where it remained for one year and then again became inflamed and persisted for the life of the patient. Seven weeks before death, vision was reduced to 3/200, the eye being considerably congested, cornea generally hazy and vascularized, exhibiting scars of old sclero-keratitis in the upper portion and deep interstitial opacities in the inner and outer lower quadrants and, near the limbus, in the lower part of the cornea, the presence of a large nodule was observed projecting into the anterior chamber. A post mortem examination showed that for a distance of about 3 mm. from the limbus above, the cornea had been converted into vascularized scar tissue, but it here contained no definite tuberculous foci. "The central portion of the cornea is relatively normal, but shows occasional vessels in its posterior layers. Near the center, an old non-vascular scar is found just beneath Bowman's membrane. The epithelium is everywhere intact. Bowman's membrane is also intact except over the scar near the limbus above, where it has been destroyed in places. Descemet's membrane and the endothelium are normal except at the site of the nodule below. This nodule is found to be a large tubercle that has involved the posterior layers of the cornea only to a depth of five or six lamellæ. Some sections show curled fragments of Descemet's membrane carried into the cornea by the tubercle. The structure of the

tubercle is unusual. Within the cornea and at its base it is composed of epithelioid and giant-cells as is usual, but its greatest mass, lying within the anterior chamber, is composed largely of fibrin. The fibrin is covered with a thick layer of fibroblasts, and the latter are also invading it from the base. It is thus evident that the large size and unusual structure of the tubercle is due to the deposition of fibrin on a tuberculous focus primarily involving the inner surface of the cornea. Whether this focus originated inside or outside of Descemet's membrane it is now impossible to determine."

Wood (*Ophthalmic Therapeutics*, p. 755) recommends the following therapy: The best treatment is that by tuberculin injection, the application of the electro-cautery, such disinfectant lotions as a saturated solution of boric acid (with atropia) in 1-5000 of sublimate, and the employment of a dusting powder of iodoform, xeroform or some other substitute for the former remedy. S. Lewis Zeigler has reported a case of *keratitis tuberculosa* treated by tuberculin. The right eye was affected, the nodes being located in Descemet's membrane. In the onset the case closely resembled interstitial keratitis, the salmon-colored patch and vascularized marginal ring being present. Later, isolated tuberculous nodules appeared.

For two months tuberculin injections of 3 to 5 minims had been administered once or twice a week. There had been a local reaction twice, and a systemic one three or four times. Improvement had been slow, but steadily progressive, and the patient rapidly convalesced, although the central opacities in Descemet's membrane would doubtless interfere permanently with good central vision.

Darier (*System of Ophthalmic Practice*, pp. 68, 69, 70) advises that treatment be commenced by very small doses of tuberculin (1/500 mgrm. of the solid substance), and if reaction be produced, the dose be diminished still further.

He suggests that before treatment with tuberculin is commenced, the temperature must be studied for several days, and an injection must never be made if there be the least trace (38° C.) of fever. The temperature should be taken four times a day and as soon as the least rise (0.05°) is observed the injections must be discontinued until the temperature has fallen to normal. When massive doses of 5 mgrms. of the active substance have been reached, injections should be made only once a week, but it is rare that doses as high as these are necessary. He adds that the question of the local injections of tuberculin is a very delicate one. They are capable of giving interesting results. The violent reaction set up by the injection may have a salutary effect by provoking an abundant vascularization of the sclerosed cornea, fol-

lowed by a partial clearing and appreciable sight. Under any circumstances, the subconjunctival injection of tuberculin should not be undertaken except with great prudence and in very feeble doses (1/10,000 of a mgrm. at the most), and especially after the ground has been prepared by a long series of hypodermic injections. Indeed, before making the injection beneath the conjunctiva, it is advisable to practice it around the orbit under the skin of the temple or eyebrow.

A. W. Lotine (*Ophthalmoscope,* p. 264, May, 1915) employs with great satisfaction, even in his public clinic T. R., but also adopts Bernheimer's plan of giving a four to six weeks' course of B. E. followed by a course of Petruschky's cutaneous method, in which the patient rubs into the skin of the arms from one to five drops of albumose-free tuberculin (T. A. F.), diluted one in five with glycerine.

Darier also believes that he has been able to check the local symptoms of irritation set up by tuberculin by one or two injections under the conjunctiva of 1 c. c. of a watery solution (by heat) of *guaiacol* 1/100. —(J. D. L.)

Keratitis ulcerativa marginalis. Under this title W. A. Martin, of San Francisco, has described cases of acute corneal disease occurring in adults and characterized by the following features: The initial symptoms are pericorneal injection and photophobia, followed by the development of a row of papillæ in the cornea about the line of the arcus senilis. These papillæ become confluent, break down, and form a line of narrow ulcers which may almost encircle the cornea. Separating the ulcerated spots from the limbus is a zone of transparent corneal tissue. The disease does not encroach upon the centre of the cornea. Under proper treatment healing occurs rapidly. In some cases, as soon as the ulcerated spots heal, others occur farther on, until the whole cornea has been traversed. Under daily use of a mild bichlorid solution and calomel insufflations healing occurs without scarring. Unlike the catarrhal ulcers described by Fuchs, keratitis ulcerativa marginalis is a primary disease.—(J. M. B.)

Keratitis, Vaccine. See **Cornea, Vaccination ulcer of the.**

Keratitis, Varicella. Chicken-pox affections of the cornea must be exceedingly rare. However, Oppenheimer (*Ophthalmic Year-Book,* p. 148, 1910) has observed a keratitis (pustule formation) as a complication of varicella. See, also, p. 2056, Vol. III, of this *Encyclopedia.*

Keratitis, Variolous. This disease, as well as smallpox, has been rendered much more infrequent than formerly owing to the introduction of vaccination. Prior to Jenner's discovery, variola and subsequently ulceration of the cornea, resulting from infection by small-pox

virus, were common affections and the latter was responsible for a large percentage of blindness.

This disease attacks the eye-lids primarily where single or multiple variola pustules appear on the lid margins (variola blepharitis), usually the lower, sometimes both, extending to the conjunctiva and subsequently attacking the corneal epithelium and later the parenchyma, usually at the limbus. However, corneal ulceration sometimes appears independently. Serious corneal affections occur most commonly in the fourth stage (stadium exsiccationis) of small-pox, and appear in various forms from the superficial circumscribed to the deep and very destructive types, which may be sufficiently severe to destroy the eye through panophthalmitis. Keratomalacia sometimes appears in this, as in other exhausting diseases, and death nearly always occurs from some complication, when the last two conditions are present.

Symptoms. The margins of the lids are covered by a heavy, grayish exudate, which becomes hard and crust-like. In severe cases the pustules appear on the conjunctiva, accompanied by severe inflammatory symptoms, sometimes so intense as to produce chemosis. Infection of the conjunctiva and cornea correspond quite closely with that of the involved area of the lid. Phlegmon of the lids may develop long after variola has disappeared and this, or the lid ulcerations, may terminate in extensive scaring and distortion of the lids.

Treatment. There is no satisfactory treatment for variolous keratitis. Bland antiseptic collyria and ointments may prove moderately beneficial.—(J. D. L.) See, also, p. 3521, Vol. V of this *Encyclopedia;* as well as **Keratitis disciformis.**

Keratitis, Vascular. PANNUS. TRACHOMATOUS KERATITIS. SUPERFICIAL VASCULAR KERATITIS. The first of these terms is used by some writers as a synonym of phlyctenular keratitis. The various forms of new-vessel formation are better studied under vascularization of the cornea, a subject fully treated on p. 3521, Vol. V, of this *Encyclopedia.* See, also, **Pannus,** as well as **Trachoma.**

Keratitis, Vascular, Deep. SALMON PATCH. In addition to the remarks on p. 3522, Vol. V, of this *Encyclopedia* it may be added here that when parenchymatous keratitis develops by the advancement of capillaries from the sclero-corneal junction into the deeper layers of the corneal tissues there generally appears a uniform, pale-red, vascularized area commonly known as a "salmon patch." This patch gradually widens, advances and extends further into the substantia propria, but it does not usually pass beyond the pupillary area, and it rarely involves more than one-fourth of the corneal circumference.

A narrow and barely noticeable margin of infiltration surrounds the advancing vascular patch. The ''salmon patch'' is densest at the corneoscleral border, gradually becoming thinner until it disappears at the free margin.

Keratitis vesiculosa. Vesicular keratitis. See **Keratitis, Bullous.**

Keratitis, Xerotic. Xerosis epithelialis of the cornea. Exhaustion ulcer. Necrosis of the cornea. See **Keratomalacia.**

Keratitis, Zonular. See **Keratitis, Band-shaped.**

Keratocele. A hernia or protrusion of the membrane of Descemet through an ulcer which has penetrated the other layers of the cornea. It is usually transparent and generally surrounded by a zone of infiltration of the corneal tissue. See p. 3502, Vol. V of this *Encyclopedia.*

Keratocentesis. Puncture of the cornea.

Keratochromatosis. A diffuse discoloration of the superficial layers of the cornea.

Keratoconjunctivitis. See **Keratitis, Phlyctenular.**

Kerato-conjunctivitis. Inflammation of the cornea and conjunctiva. See, for example, **Keratitis fascicularis.**

Keratoconus. Conical cornea. Hyperkeratosis. In addition to the matter included under the heading on p. 2976, Vol. IV, of this *Encyclopedia,* some recent observers have since contributed substantial additions to our knowledge of this peculiar disease.

Of the numerous discussions touching the *etiology* of kerataconus the essay of E. von Hippel (*Klin. Monatsbl. f. Augenheilk.*, p. 273, 1913; George Coats' abstract in the *Ophthalmic Review,* page 111, April, 1914) is noteworthy as showing how far afield even reliable observers go in their efforts to solve the mysteries of pathogenesis in this mysterious affection. He draws our attention to the statement of Siegrist that patients with conical cornea are often thin, nervous, pale, with dry skin and a tendency to loss of hair, of weak memory; and that they show characteristic blood changes—an increase of lymphocytes and a lessened coagulation period. He believes these symptoms to be due to diminished activity of the thyroid, or of one of the other glands which preside over internal secretion. In confirmation of this observation Dor has reported the cure of a case of conical cornea, with exophthalmic goitre, by means of thymus treatment. In Augstein's case trophic disturbances of the skin and nails were present, lymphocytes were increased to 32 per cent., but there was no hastening of the coagulation; these lesions, as well as the conical cornea were favorably influenced by a preparation of thyroid. On the other hand Strebel and Steiger's results were negative. Fleischer

found neither lymphocytosis nor increased coagulability; two of his patients were thin, pale and nervous, but without organic disease, two had slight enlargement of the thyroid, but no anomalies of the nails, hair or skin. v. Hippel is of opinion that these results point to the presence, in some cases of conical cornea, of disordered function in one or other of the glands in question; the symptoms, however, are equivocal, and do not indicate with certainty which gland is affected.

It was to obtain light on this question that the author had recourse to Abderhalden's reaction. He assumes that we all know what this is, but fortunately proceeds as if we did not. It is a reaction for testing the metabolic activity of various organs. When the metabolism is disturbed substances foreign to the plasma are thrown into the blood. These give rise to the formation of defensive ferments, which are almost specific towards the diseased organ, the colloids of which they are capable of disintegrating by peptonization, thus rendering them more susceptible to dialysis. If, for instance, a piece of thyroid be immersed, in a dialysis tube, in the serum of a patient with disordered function of the thyroid, and if the tube be placed in the incubator for 16 hours, dialyzable disintegration products of the thyroid will escape into the fluid surrounding the tube, where they can be detected by the reagent ninhydrin, with which they give a blue color. Nothing of the kind would happen with any of the glands in question if immersed in normal serum. To detect which gland is affected therefore it is only necessary to perform a separate experiment with each.

Applying this test to two cases of typical conical cornea, and one of generalized keratectasia, v. Hippel found disturbance of the glands of internal secretion in all three. The thymus was most frequently and most markedly affected; the suprarenal gave a positive reaction in two cases; the thyroid one positive, one doubtful and one negative reaction; the pancreas a slightly positive reaction in one case; the hypophysis a doubtful reaction in one. As might be expected corneal tissue gave a negative reaction. If the association hypothecated by Siegrist exists, therefore it is the function of the thymus which is disordered. v. Hippel is inclined to believe that the association if not absolutely proved for all cases, is yet a real one. The grounds for the assumption seem, however, to be somewhat slender. In one of his own cases a subsequent test with thymus gave a negative reaction; and the same occurred in one out of five cases to which he refers in an appendix; in another instance the result was exceedingly equivocal. On a priori grounds it might seem probable that, in an adult, tests with a retrograding gland like the thymus would frequently show disturbed metabolism; at any rate the point should be

settled by a considerable series of control tests. v. Hippel says that positive results are not to be expected in all cases of conical cornea, because the functional activity of the glands may vary from time to time; in old-standing cases of the disease also the cause of the condition may be no longer operative. But if this be granted the value and suggestiveness of the test becomes very nebulous.

Uhthoff (*Klin. Monatsbl. f. Augenh., Schmidt-Rimpler Festschrift,* p. 41, 1909) obtained the entire globes of a case of bilateral keratoconus which was of recent development. It had followed a general trauma not involving the head. The eyes were previously myopic. He found the membrane of Descemet normal in one eye and ruptured in the other. The epithelium varied in thickness in the center of the cornea, but was normal at the periphery. There was no change in the ciliary body. He agrees with Axenfeld that the rupture of the membrane of Descemet was the result, not the cause of the conus.

Parisotti (*Bull. Société française d'opht.,* 1909) also believes that lesions of the membrane of Descemet are not the cause of keratoconus, but are secondary. He thinks the cause is a diminished resistance of the central portion of the cornea which renders it incapable of bearing the normal intraocular pressure. The cause of the diminished resistance he thinks is congenital and is probably some defect in the structure of the central corneal tissue. He assumes that the elastic fibres are wanting and would have further research directed in this direction. Treatment in the first stage should be confined to optical correction, the use of miotics and a bandage at night. If the case is progressing, mild surgical measures should first be adopted, such as paracentesis of the periphery of the cornea and especially incision at the base of the cone as proposed by Schiess. In advanced cases or when rapidly progressing he would cauterize through all the corneal layers and later do an optical iridectomy. Hygienic measures should not be overlooked.

Kaz (*Ophthalmic Review,* p. 57, Feb., 1912) reviewing the contributions of S. Golovin (*Wiestn. Oftal.,* July and Aug., 1911) on the surgical treatment of keratoconus, says that the author in operating on a young medical student, perforated the cornea with the cautery. As the anterior chamber did not reform for 23 days, Golovin transplanted a conjunctival flap over the fistula, using the method suggested by Kuhnt in the treatment of severe corneal ulceration. He first refreshed the margins of the fistula with the curette and then separated a flap of 4 to 5 mm. in breadth at the outer side of the cornea and extended it over the cornea, fixing it above and below with sutures. The anterior chamber reformed in three days, and four days

later the sutures were removed. In nine and fifteen days respectively the upper and lower portions of the flap were separated up to the pupil and replaced in their original situation. The quadrangular piece of conjunctiva which remained in the middle of the cornea, under the continued use of eserine, was transformed into a round leucoma, which was then tattooed, and an iridectomy performed on the inner side. A year later the keratoconus had not progressed and the vision had risen from finger counting at three metres to 0.7.

Golovin is of the opinion that the transplantation of a conjunctival flap, which he was driven to make as a result of the non-closure of the anterior chamber, might be of service as an original method of treatment of keratoconus.

Wray (*Trans. Roy. Soc. Med. Ophth. Sec.*, June 10, 1913) is opposed to waiting until there is extreme thinning of the corneal cone. When the diagnosis is certain and the correcting cylinder is over 6 diopters, active treatment is urged, especially if the patient is over 25 years of age. Snell's cautery, almost black heat, he finds most satisfactory, and advises against doing too much at one time. When the apex is thin and pulsation pronounced, he thinks it worth while to perforate and thus destroy the center. Unusually good results he had obtained from the cautery are reported by Adams (*Ophthalmoscope*, Vol. 12, p. 132, 1913). The last twenty cases he operated on showed improvement in vision from 6/60, or less, to 6/30 to 6/9. In order to keep the tension low during the process of healing Elliot's trephining was added to the procedure in the last eight cases. The operation described, not only replaces the weakened corneal tissue with a firm scar, but assures every opportunity for the scar to solidify under the most favorable conditions.

Weeks does not consider it an easy task to detect the earliest stages of conical cornea by the ordinary methods, but prefers for this purpose the ophthalmometer of the Javal type. He points out that since the cone is not a segment of a sphere, an ellipsoid nor a parabola, but a mixture of them all, the line of the image of the mires is broken at their intersection and frequently slightly curved.

It will also be found that a meridian in which the central dividing lines of the mires, when their images are brought into apposition, fall in a straight line does not exist. The deflection of the lines of the mires at either side of the middle is in the direction of the torsion of the line of most acute curvature when the radius of that approximate meridian is being measured, while the images of the mires are broadened in the direction of least curvature. If the image of the combined mires is sharp at their opposing margins, it will be blurred at the margins of

the extremes of the image, the blurring being greatest in that portion of the image lying in the direction of the most acute curvature, because that portion will be most out of curvature. The lines of the images are not irregular in the early stage, consequently cannot be confounded with the images of the mires seen in irregular astigmatism due to corneal ulcer or injury. Another point of differentiation is the binocular character of keratoconus. The principal meridians are rarely at right angles, the difference ranging from 1 to 10 degrees. As a rule the apex of the cone is reached by a more acute curve above than from below, but the meridian of greatest curvature is seldom directly vertical in its upper half. Pulsation may be met with at a comparatively early stage but Weeks has never seen it in cases that have been stationary for a period of three years or more.

Weeks gives an account of fourteen cases under his care in five of which *operative treatment* was made use of. He advises operation in cases where the vision has sunk to 8/200 or less.

The operation in these five cases consisted first of an iridectomy upward, upward and inward or upward and outward. Ten days later the apex of the cone was cauterized, the cauterized area being oval with its long axis horizontal and seldom extending above the horizontal meridian of the cornea. Cauterization was performed with a platinum point heated to a red heat in a spirit lamp. The eschar was carried as deep as possible at the apex without perforating the cornea. A compress bandage was worn for three weeks and for two months longer at night. In one case the epithelium over the scar behaved like an erosion keratitis in becoming detached but eventually settled down. There were no other complications and the results were good, though naturally in these advanced cases no great improvement in vision was obtained.—(*Oph. Review,* p. 219, Jan., 1914.)

Keratodeitis. (Obs.) Keratitis.

Keratodeocele. (Obs.) Keratocele.

Keratodeonyxis. An old form of keratonyxis.

Keratoderma. 1. A horny skin or covering. 2. The cornea.

Keratodermatitis. (Obs.) Keratitis.

Keratodermatomalacia. Pathologic softening (or sloughing) of the cornea; an old form of keratomalacia.

Keratoglobus. BUPHTHALMIA. MEGALOCORNEA. KERATOMEGALY. HYDROPHTHALMUS. In this disease the cornea, as a whole, assumes proportions greater than in normal eyes. It becomes ectatic all over, and, with the eyeball, is quite uniformly enlarged in all its dimensions.

Hydrophthalmus is a disease of childhood, usually affecting both

eyes, which appears at birth, or soon afterwards, characterized by a distension and gradual thinning of the cornea and sclera. The anterior chamber is deepened, the iris is tremulous, sluggish and atrophic; conditions which are the result of intraocular pressure. Examination of the fundus reveals a marked cupping of the disc, due also to the increased intraocular tension. This condition is sometimes called *glaucoma congenitum*. In some cases the cornea retains its normal lustre and transparency, when it is called *keratoglobus pellucidus;* but it is usually dull, generally cloudy and becomes flattened, and hence termed *keratoglobus turbidus.* The opacities are sometimes band-like, striated and well-defined. These striated opacities are caused by lacerations of Descemet's membrane, due to the excessive tension. Examination of these striated opacities with the loupe reveals very fine lines, which are fissures in Descemet's membrane.

Etiology. Heredity seems to play an important rôle in this affection. Impairment of vision is in keeping with the extent of the involvement of the ocular tissues; when this is marked the eyesight is entirely lost.

Treatment is by no means encouraging, as most cases end in blindness or in the loss of useful vision. If the condition is recognized very early, corneal trephining by the Elliot method will prove more or less effective in some cases.—(J. D. L.) See, also, **Buphthalmia;** also, **Juvenile glaucoma,** as well as **Congenital anomalies,** p. 2829, Vol. IV, of this *Encyclopedia.*

Keratohelcosis. Ulceration of the cornea.

Keratoid. Resembling horn or corneal tissue.

Keratoidea. See **Galen, Claudius,** p. 5331, Vol. VII of this *Encyclopedia.*

Keratoiditis. Inflammation of the cornea.

Kerato-iridocyclitis. Inflammation of the cornea, iris, and ciliary body.

Kerato-iridoscope. A form of compound microscope for examining the eye.

Keratoiritis. An inflammation involving both the iris and the cornea.

Keratokystitomie. A term applied by Gayet (*Annalec d'Oculistique,* Vol. 95, p. 227, 1886) to the act of opening the capsule of the lens with the knife during the extraction of cataract. See p. 1688, Vol. III, of this *Encyclopedia.*

Keratoleucoma. (L.) A white spot on the cornea; albugo; leucoma.

Keratoma. A horny growth or tumor. See p. 3524, Vol. V, of this *Encyclopedia.*

Keratomalacia. Xerotic keratitis. Necrosis corneæ. Infantile ulceration of the cornea. Softening and degeneration of the corneal

tissue; especially a form of corneal disease occurring in children in connection with a severe and frequently fatal general disease. It is characterized by hemeralopia, the formation of xerotic spots upon the cornea, and ulceration of the latter, which may be very extensive while the local symptoms of inflammation are often slight.

To the information on p. 3378, Vol. V of this *Encyclopedia,* there may be added the observations of Stephenson (*Prac. Med. Series,* p. 42, 1912) and Kapuscinski (Graefe's *Archiv f. Ophthalm.,* Vol. 82, pt. 2, 1912). The former observer finds that infantile keratomalacia is known in practically every country the scientific records of which are available for inspection. It affects children whose ages usually range from three to twenty months, and is especially frequent at about the eighth month of life. It occurs chiefly in children of the poorer classes. It affects both eyes in about one-half of the babies. It is associated with xerosis conjunctivæ in about 50 per cent. of the cases. It occurs only in babies whose vitality has been seriously reduced by epidemic or zymotic enteritis, congenital syphilis, athrepsia, or tuberculosis, named in their order of frequency. In London its seasonal incidence closely follows that of zymotic enteritis. Its mortality amounts to about 50 per cent. of those affected. The immediate cause of death is usually broncho-pneumonia or exhaustion. It leads to blindness in about one-half of the children who survive. It is associated with no specific micro-organisms, although in scrapings from the cornea the pneumococcus may be found in about one-half of the cases.

Kapuscinski bases his observations chiefly on a series of thirty-one cases observed by himself. He points out that not every child afflicted with the disease was in a poor state of health.

Fourteen of his cases died. In the vital prognosis three factors are of importance, the patient's age, the nutritional condition, and complications, especially broncho-pneumonia.

Both eyes were affected in 24 cases, one eye only in the remaining seven instances.

By far the largest number of Kapuscinski's cases occurred during the first six months of life, and included eleven deaths. As regards nutrition, in seven cases it was noted that the child was fairly well nourished, but not up to normal standards, and of these seven two died, one from broncho-pneumonia, the other was not admitted and died at home, so the cause of death was not ascertained. Broncho-pneumonia accounted for seven deaths in eleven cases, the rest died from emaciation, gastro-intestinal disturbance, etc., and one from septicemia.

As this series contains seventeen out of thirty-one cases where death did not ensue, the author thinks that the prognosis is not so black as it is usually painted, although it is bad enough in any case. He found albumin milk of considerable service in the treatment of the accompanying intestinal catarrh.

Keratome. This is the instrument of choice for all linear corneal incisions where a limited opening is required. The blade is prac-

Straight Jaeger Keratome.

Agnew's Angular Keratome.

tically a triangle, the length of each cutting edge being slightly greater than the base. See, also, **Iridectomy.**

Keratomegaly. See **Keratoglobus.**

Kerato-meningitis. (L.) An old term for keratitis.

Keratomeninx. (L.) An obsolete name for the cornea.

Keratometer. An instrument for determining corneal astigmatism, or, rather, for measuring the corneal curves. This caption will be discussed under **Ophthalmometer.** See, also, p. 4709, Vol. VI, of this *Encyclopedia.*

Keratometry. OPHTHALMOMETRY. Measurement of the corneal curvatures. See **Ophthalmometer**; also **Examination of the eye.**

Keratomus. (L.) Keratotome.

Keratomy. See **Keratatomy.**

Keratomycosis. MYCOTIC KERATITIS. MYCOSIS OF THE CORNEA. An affection of the cornea due to invasion of its tissues by some species of mold, especially of the *Aspergillus;* much more rarely from Actinomycosis.

This subject had already been discussed to some extent on p. 3335, Vol. V, of this *Encyclopedia*, and elsewhere. Here attention is directed to the fact that the first case was published by Leber in 1879; it resulted from the husk of an oat grain flying into the eye. The second case was published by Berliner (1882) and investigated later by Uhthoff; it followed a blow by a pear.

As a rule, the central area of the cornea is infiltrated; it later undergoes superficial disintegration, and is distinguished by its dry,

crumbling surface. A grey or yellow line of demarcation forms about this area, gradually deepening into a gutter, and ultimately leading to the exfoliation of the enclosed portion of cornea, which in the meantime has become necrotic. Hypopyon is present, but the irritative symptoms are slight, the whole course being very chronic.

Isakowitz points out that when the fungus lodges near the limbus the case is generally mild. If the center of the cornea becomes inoculated the result is hypopyon keratitis. He reports such a case caused by the *Aspergillus fumigatus.* The mycelium was seen growing into the tissue about the point of infection. A ring of leucocytes formed which separated the necrotic tissue from the healthy cornea and a sequestrum was cast off. Severe iritis was present. Fifteen cases of the severe type have been reported; in all the cornea was destroyed. An abortive form has been described by Axenfeld in which the sequesttrum is found to contain no necrotic tissue but to consist of mycelia. The writer, analyzing the reported cases, discovered that in the severe cases no foreign body was found, but in the mild cases one was nearly always present. He suggests that the foreign body may set up an inflammatory reaction which prevents the penetration of the fungus.

In a case reported by Morax the organism was found to be the Verticillium graphii, an organism which he found only pathogenic when inoculated on the surface of the cornea. The lesion caused was a white spot 3 mm. in diameter at the center of the cornea, and a small hypopion. There was little pain. The mass was easily detached leaving an ulcer which was touched with the galvano-cautery. A month later vision remained reduced to $5/50$ on account of the corneal irregularity.

Verderame (*Annali di Ottalmol.*, p. 223, 1913) believes in the variability of the evolution of keratomycosis, of which the clinical forms may be more or less grave, for reasons both complex and ill-understood. The results of experimental inoculation in animals are not always applicable to those which take place in man, and Markow has thus shown that a certain strain of aspergillus may manifest a very pathogenic action upon the human cornea, while showing itself quite inactive upon that of laboratory animals. In mild cases the cure of keratomycosis aspergillina usually takes place spontaneously, or by the treatment ordinarily applied to ulcerations of the cornea. In grave cases, on the contrary, the keratitis takes the form of atypical hypopyon, but we must abstain from all hasty intervention, as corneal section or the cautery, which may entail irreparable lesions, while the regressive phase of the process may speedily come about and end in cure with comparatively slight changes of the cornea.

Cavara (*Ophthalmic Year-Book,* p. 153, 1914) describes a variant from the usual form of the disease, the infection following a blow on the eye with a clod of earth. The subjective symptoms were slight photophobia, and a sensation as of a foreign body in the eye. The lesions appeared as two white, opaque raised areas, the larger somewhat pyriform and the size of a pin head, with sharply-defined outlines, and approached by a leash of blood vessels from the limbus. There was no surrounding infiltration of the cornea. Recovery was rapid. The parasite isolated was a slightly interlacing mycelium, of snow white color on ordinary culture media, except that on potato, milk and bread pap the color was a leaden gray. It was pathogenic if inoculated into the veins or peritoneum of the rabbit, guinea pig or rat. It was pathogenic for the ocular tissue of the rabbit and guinea pig. This is described by the author as the first case of keratomycosis proved to be due to *Mucorinea.* For this species of *Mucor* he proposes the name *M. cornealis.*

Keratonecrosis. See **Keratitis, Neuroparalytic.**

Keratonosus. Any disease of the cornea.

Keratonyxis. A term applied by Buckhorn to discission or needling of cataract. See p. 4022, Vol. VI, of this *Encyclopedia.*

Keratophyte. A bacterial form which Rosenhauch (*Klin. Monatsbl. für Augenheil.,* Nov., 1909) found in serpent ulcer. It is a comparatively large, Gram-negative microbe, and sometimes appears as a thick rod, sometimes as a diplococcus. In its growth on agar it resembles the fungi. It is easily killed by the sun's rays, while inoculation experiments show it to be pathogenic for animals.

Keratoplasty. See **Cornea, Transplantation of the,** p. 3483, Vol. V, of this *Encyclopedia.* This term is sometimes, though improperly, used as a synonym of *conjunctivoplasty* (in corneal ulcer) as discussed on p. 3508, of the same volume.

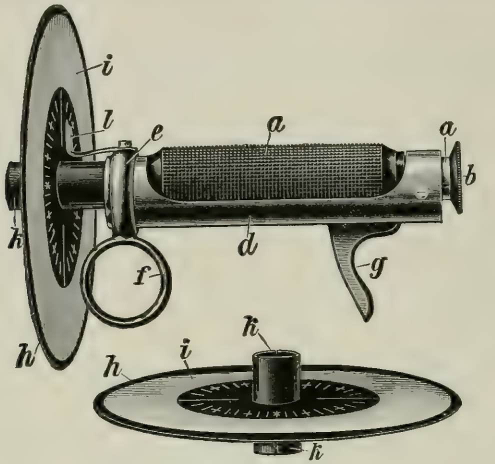
Keratorrhexis. (L.) Rupture of the cornea either from a perforating ulcer or from external injury.

Keratoscleritis. Associated inflammation of the cornea and sclera.

Keratoscope. Astigmoscope. Placidoscope. Keratoscopic disc. An instrument for observing abnormal curvatures of the cornea, consisting of a disc bearing black and white circles, which, in case of anomalous curvature, appear to be distorted figures instead of circles.

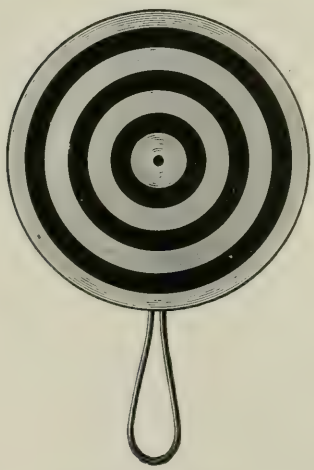
The best known forms of this instrument are those of Javal and Placido. One variety of **Placido's disk** is described on p. 660, Vol I, of this *Encyclopedia;* two others are also depicted here. Some of these instruments are so arranged that the lens placed before the central

aperture that makes the distorted figures appear uniformly round expresses the character and amount of the corneal astigmatism.

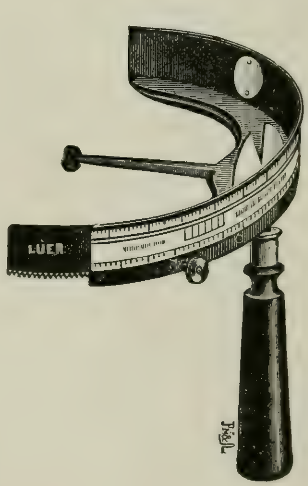


The Keratoscope of Gertz.

The rotating tube, *a*, of the instrument is held close to the eye by means of the finger-ring, *f*, and the rest, *g*. The disk is turned and the examination made practically as with the ophthalmometer.



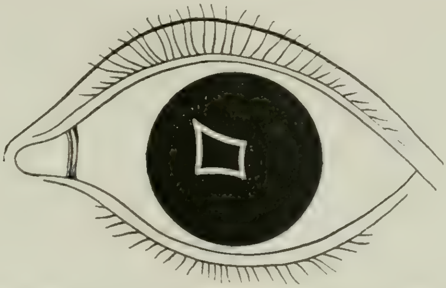
Placido's Disk.



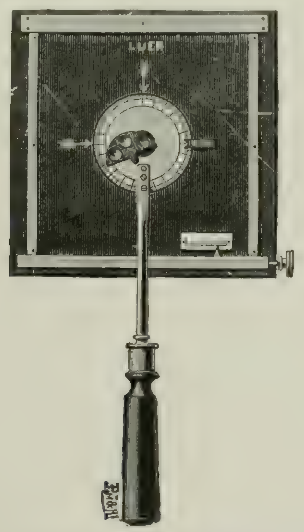
Keratoscope of de Wecker.

The keratoscope of Gertz is really a small hand-keratometer or ophthalmometer and furnishes a rough-and-ready measurement of the corneal astigmatism and may be used for prescribing the correcting lens.

The *registering keratoscope of de Wecker and Masselon* is based upon the image formed on the cornea of a white square on a black ground. On examining a case of keratoconus with this instrument, and causing the gaze to be so directed that the apex of the keratoconus coincides with the axis of the instrument, one sees the sides of the image of the square assume the form of curves with their convexity towards the middle.



Deformity of the Corneal Image of a White Square in a Case of Keratoconus. (After Masselon.)



Registering Keratoscope of de Wecker and Masselon.

Keratoscopy. An incorrect term for a method of determining the refraction of an eye by inspecting the reflex from the pupil; more properly called skiascopy, retinoscopy, pupilloscopy, or the shadow test. See **Examination of the eye.**

Keratosis conjunctivæ. Cornification of the conjunctiva. Mohr and Schein (*Archiv f. Augenheilk.*, Vol. 39, p. 231) have described an example of this extremely rare condition in a man, 46 years of age, who had a well defined ulceration of the conjunctiva. Typical corneal tissue was found in the affected area.

Keratosis nigricans. Acanthosis nigricans. This skin disease may affect the lids and the conjunctiva. The condition is characterized by the development of pigmented warty growths, accompanied by similar growths on the dermal surface of other parts of the body.

E. T. Boyd (*Ann. Ophthal.*, July, 1915) records one of the fifty cases found in literature.

A woman, 54 years old, complained of epiphora and that her eyes caused her much mental anguish because of their unsightly appearance. On the margin of the right lower lid were two large papillomata, their bases merging. There was also a large papilloma at the inner corner of the right upper lid. In the inner corner of the left eye, arising from the caruncle, there was also a large papilloma and it was this one in particular that was giving her most trouble.

Two years before, being troubled with constipation and hemorrhoids, she, at the suggestion of a friend, began rectal injections of salt and water, using, according to her statement, "salt by the handfuls." This she did once or twice a day for a long period of time. Then her mouth began to trouble her. Ten months before papillomata began to appear on the extensor surface of the forearms, to a lesser extent upon the arms, and in great profusion upon the back of her neck. In the latter situation there remained marked pigmentation. There was a papilloma in one external auditory canal and a mass, probably papillomatous, in the roof of the mouth well forward and flush with the biting surface of the teeth, that had the appearance of fine grained granulation tissue. She had lost thirty pounds in the ten months and was in a deplorably despondent mental state, so that it was difficult to say whether this loss of weight and her cachectic appearance were entirely due to a cancerous lesion or were the result of mental worry.

The disease is, in all probability, following Crockers classification, keratosis nigricans, or, following Stelwagon, acanthosis nigricans.

Couilland and Darier believe that the disease is a syndrome dependent upon abdominal carcinosis and characterized: 1. From a clinical viewpoint, by: (a) a papillary hypertrophy and a cutaneous pigmentation having an essential regional character; (b) papillary hypertrophy of the mucous membrane; (c) dystrophy of the hair and nails; (d) absence of desquamation; (e) existence of cachexia. (2)

From a pathologic standpoint, by carcinomatous degeneration of the abdominal organs. 3. Histologically, by lesions of hypertrophy and pigmentation in the rête and corium. Treatment may be either expectant or surgical; but from the standpoint of the ophthalmologist when the eye or eyelids are involved there can be but one course to pursue, and this coincides with the advice of Crocker in treating keratosis nigricans, when he says: "Remove any wart or papillary growths which from their position, are a special annoyance." It is not impossible nor unlikely that the absorption of large quantities of sodium chloride over a long period of time may have so modified metabolism as to have become the prime etiologic factor in this case.

Keratosis pilaris. LICHEN PILARIS. LICHEN SPINULOSUS. PITYRIASIS PILARIS. A chronic affection of the skin marked by a pin-head-sized conical elevation investing the hair-folicle, and somewhat resembling goose-flesh and ichthyosis. The skin becomes dry and hard, and feels like a nutmeg-grater. The disease appears in working-men who are uncleanly, and in scrofulous children, and it occurs chiefly on the thighs, arms, and forearms. It rarely attacks the palpebral skin or conjunctivæ. Morax, however, notes a case of alopecia of the lids due to this disease.

Keratosis seborrheica, Ocular relations of. Seborrheic keratosis rarely affects the eye. It is a common cutaneous disease that most frequently occurs in elderly people, and especially, as its name implies, in those who have a seborrheic skin. Light, especially the actinic rays of light, is now considered to be in many cases the exciting cause of the trouble. There is no direct evidence in support of this view, but, according to Douglass M. Montgomery (*Jour. Am. Med. Assocn.*, Jan., 1913), there are a number of phenomena difficult to interpret in any other way: 1. Patches of seborrheic keratosis begin very frequently as small pigmented spots, and the formation of pigment is a well-known effect of the action of light. 2. Seborrheic patches occur most commonly and most profusely in persons exposed to light. 3. They appear almost exclusively on the exposed surfaces of the face, ears, neck and back of the hands, and the lesions, as a whole, are analogous to those of xeroderma pigmentosum, a disease in which light is known to be the exciting cause. 4. Furthermore, chronic dermatitis from prolonged exposure to x-rays, which are particularly actinic, presents the same set of symptoms as xeroderma and seborrheic keratosis, and eventuates, as they do, in epithelioma. To demonstrate what an important rôle light plays in the development of seborrheic keratosis William Dubreuilh (*Ann. de dermat. et de syph.*, p. 387, June, 1907) collected the material in his clinic in Bordeaux and found that of

162 patients, 101 had outdoor and 61 indoor occupations; that is to say, 62.5 per cent. of them were exposed to the sun, while 37 per cent. were not. See, also, **Light effects on the eye**; as well as **Blindness, Snow.**

Keratotome. An old term for any knife or cutting instrument used in incising the cornea, a keratome.

Keratotomy. Saemisch section. Guthrie's operation. Keratomy. Kerotomy. Corneal incision. Ceratotomy. Cerectomy. An early but long forgotten definition of keratotomy is "any incision of the cornea, especially for the extraction of cataract." It is *now* uniformly referred to the so-called Saemisch* section (or more properly Guthrie's operation) for the relief of hypopyon ulcer of the cornea. This procedure is carried out (see Wood's *System of Ophthalmic*

Taylor's Keratomy Knife.

Operations, p. 957) as follows: The conjunctival sac is cleansed as well as possible. The eyelids are separated with a stop speculum and the eyeball is steadied with a pair of fixation forceps. A puncture of the cornea in the clear portion of the membrane, about a millimeter's distance from the margin of the ulcer, is made with a narrow von Graefe knife with its cutting edge directed forwards. After the knife has entered the anterior chamber, the blade is moved along the bottom of the ulcer until it reaches a similar point in the clear cornea to the nasal side of the ulcerous area. The ulcer is then bisected, the instrument being given a series of slight lateral movements in order to allow the aqueous humor and the removable solid contents to escape along the side of the blade. A fine forceps or a flattened spatula, to remove any remaining débris, may be useful. The writer has not infrequently brought out the entire fibrinous mass by gentle manipulations with the two instruments. The parts are flushed with sterile water or a saturated solution of boric acid. Atropine is instilled. A compress bandage is carefully applied. It is best in old subjects to give some form of anodyne after the procedure, which does not necessitate general anesthesia; though there will be but little or no pain if the operation be done deliberately, properly and quietly. The after-treatment must be supportive and ameliorative.

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*There is an excellent and convincing parallel review of the question of priority—Guthrie v. Saemisch—by Stephenson, in the April, 1910, number of *The Ophthalmoscope.* Of particular interest in this regard, is Guthrie's communication published in the 19th of March, 1844, number of the *Medical Times.* Also see the claims of Heuermann (1765) as set forth in the *Centralb. f. pbt. Augenheilk,* p. 261, 1890.

The operation of Saemisch, which he himself modified later, carried the corneal incision through the ulcerous area. An excellent and well illustrated description of the Saemisch section is given by Heymann (*Ophthalmologische Operationslehre, speziell für Prakt. Aertze und Landärtze*, 1903, S. 52). Alfred Graefe (*Klinische Monatsblätter für Augenheilkunde,* 1872, S. 173) recommended that the carriage of the section be made in the apparently healthy cornea near the diseased portion of the membrane.

Meyerhöfer made the cut as a tangent to the ulcer and then slit the infiltrated border, and that in the direction of its greatest progress. As Beard (*Ophth. Surgery,* 1910, p. 384) observes, since part of the object of the incision is to drain and relax the infiltrated tissue, as in orbital phlegmon, this would seem rational.

Many cases suffer reinfection, but by repetition of the incision associated with careful cauterization whenever necessary, and constant application of hot stupes in connection with rest in bed, and attention to the emunctories, the use of stimulating diet and treatment directed towards any dyscrasia, comparatively quick recoveries with useful eyes may, as a rule, be gotten.

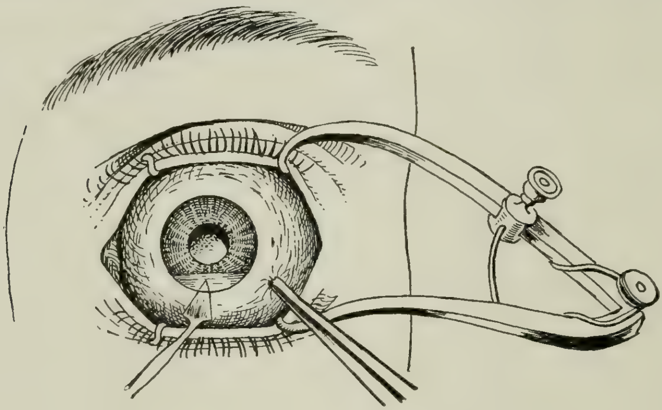
The original method of Saemisch, Wells tells us (*Diseases of the Eye,* Fourth American Edition, 1883, p. 233) was to carefully and repeatedly open the wound of operation by the insertion of a blunt-pointed instrument between its lips once or twice daily, in order to allow any reaccumulated material to escape; the wound being permitted to close at the end of the second or third week. In the writer's experience this repetitive interference with the wound has not been necessary.

Schwenk's modification of the Guthrie-Saemisch section. Schwenk has carefully modified "Saemisch's method of incision" in the following way. He resorts to it only under general anesthesia, as he has found that the release of intraocular tension gives rise to pain. After the parts have been cleansed and a speculum placed in position, he introduces a narrow von Graefe knife—the width of which must be less than the depth of the anterior chamber—one or two millimeters posteriorly to the outer margin of the ulcer—and transfixes it directly to the opposite side of the cornea, keeping the hilt of the instrument as near to the plane of the iris as possible. After having made a counter-puncture, he rotates the knife gently on its axis, but, while doing so, he makes gentle backward pressure with its hilt, the pressure being kept equal to the amount of the bulbar tension in order to hold the iris as much as possible in position, and thus he be enabled to evacuate the contents of the anterior chamber before the completion of the

cut. He thus gradually releases all of the tension. This done, he completes the incision by a movement carried directly forward, cutting the ulcer through its center. The fibrinous masses are then removed, and the anterior chamber is cleansed as much as possible.

The author tells us that this operation has proved of much value in his hands. He makes the important note that he has had many cases in which the post-operative result has been uncomplicated by anterior synechia.

Wolfe's (*On Diseases and Injuries of the Eye,* 1882, p. 77.) method is to introduce a narrow lance knife at the lower border of the corneo-scleral junction, as shown in the accompanying figure. Gentle pressure on the inferior lip of the wound is made during the withdrawal of



Wolfe's Method of Removal of Hypopyon, by Keratotomy.

the instrument, allowing the accumulated material to pass out. Any remaining portions are removed by the aid of a small iris forceps and a flat silver probe bent at a suitable angle.

In some cases, in which the cornea is not greatly infiltrated nor necrosed, the writer has obtained most excellent results by resorting to Wardrop's and Wolfe's method of making a peripheral section just within the corneal limbus on the same side as the best portion of the ulcer (preferably the upper). He picks out the free portions of the organized leucocytic (as a rule) masses in the anterior chamber and corneal lamellæ (Horner and Bokowa, *Inaugural Dissertation,* Zürich, 1871) with a pair of fine capsule forceps. The after-treatment is as above given. Healing without iris incarceration is uninterrupted, and excellent visual results are nearly always obtained.

Wood (*Practical Medicine Series of Year Books,* Vol. III, 1902, p. 43) believes "that when other methods fail to cure serpiginous ulcer

with hypopyon, the Saemisch section should not be employed, but Haab's iodoform discs introduced into the anterior chamber through a peripheral incision in the cornea.'' This plan will be found free from many objections to the old form of section, and it permits of better drainage of the anterior chamber and all of its antiseptic treatment. See, also, **Cornea, Serpent ulcer of the.**

Combined transverse keratotomy. Chevallereau recommends this method of operative procedure in cases of definitely lost or deformed eyes over which it is desired that artificial eyes may be successfully worn without discomfort or danger. He employs the method in cases of buphthalmos, absolute and secondary glaucoma, and in corneal staphyloma.

Although such a plan has never seemed rational or safe to the writer, yet it is here given as merely explanatory of the necessary operative details to be pursued.

The cornea is transversely cut through its entire width, and the iris and crystalline lens are removed without any injury to the more deeply placed choroid and retina.

The eyeball gradually shrinks, though retaining its rounded form, and the cornea, though smaller, becomes well-curved, thus making an excellent and freely mobile stump over which to place a glass shell. It is well not to attempt to insert an artificial eye into the conjunctival sac until several weeks have elapsed after the procedure.

G. B. Jobson (*Ophth. Record*, July, 1912) strongly recommends keratotomy (actually a *keratectomy*) for corneal scars. A perpendicular cut is made with the keratome around the scar or opacity to an extent commensurate with its depth, going through, successively, the anterior epithelial layer, Bowman's membrane and the substantia propria. The success of the operation depends upon the removal of the abnormal tissue in layers, until clear cornea is encountered. If this is done correctly, the surface will be comparatively smooth, clear and parallel with the uncut corneal surface. In other words, the last layer must be intact. Care must be exercised that the underlying elastic Descemet's membrane is not cut into. Jobson has performed this operation, with more or less success, upon 15 patients.

Kerectasia. Bulging of the cornea that has become soft and pliant from disease. A synonym of keratectasia.

Kerectomy. A synonym of keratectomy.

Kern. (G.) Nucleus.

Kernbogen der Linse. (G.) Nuclear portion of the lens.

Kernig's sign. 1. In the dorsal decubitus the patient can easily and

completely extend the leg; in the sitting posture the leg cannot be completely extended: it is a sign of meningitis. 2. Hypertonia.

Kernstar. (G.) Nuclear cataract.

Keroid. Resembling the cornea.

Kerosene. See **Illumination**; as well as **Light.**

Kerotomy. This name was given to an operation (See Wood's *System of Ophthalmic Operations,* Vol. II, p. 955) devised by George Edward Walker (*Liverpool Medico Chirurgical Journal,* 1889) in 1886. The reason which led Walker to follow this procedure was the following: He had been impressed by the value and also by the disadvantages of the operation of cutting across a severe ulcer from clear cornea to clear cornea, which Guthrie (*Medical Times,* 28th October, 1843, and February and March, 1844) had advocated in his lectures and "which was revised by Saemisch, and which now unfairly bears his name" (*The Ophthalmoscope,* November, 1909, p. 740).

The history of the causes which led to the method of procedure is interestingly described as follows: "In 1886, a case of severe chronic inflammation of the cornea which had resisted treatment for months was brought to Mr. Walker, who found that the whole cornea was involved. Under these circumstances, he argued, 'If a diametrical incision would relieve even worse corneal tension than that which I had before me, why should not a series of shorter incisions whose total length should be the equal or nearly to the length of the diametrical incision do the same? And if so, why should not these shorter incisions be made at the base of the cornea, where they would cause neither damage to the sight nor disfigurement?' "

Based upon this thought, he states that "in less time than it has taken to record this, I conceived and performed the operation, the amount of blood and germs which escaped from the incision showing what a relief had been afforded to the cornea, which cleared up perceptibly whilst the operation was proceeding." (The author remarks that this clearing up is a very striking feature in the operation, and has often been remarked by those who have done it.) He goes on to say that "all doubt as to the benefit of the method was soon removed. After recovery from the chloroform the girl expressed herself as quite relieved from the old pain and, two days afterwards, spontaneously opened her eyes for the first time in three months."

As A. Nimmo Walker (*The Ophthalmoscope,* November, 1909, p. 740) says, the operation is simple. It is best described in his father's original words. "Standing behind the recumbent patient, insert the speculum and fix with toothed forceps the conjunctiva opposite the lowest point of the cornea. Then thrust a broad needle through the

sclera, just behind its junction with the cornea, until the shoulder of the needle is visible in the anterior chamber. Of course, the blade must be held nearly parallel with the plane of the iris, but the puncture should be oblique and valvular, so that on the withdrawal no aqueous escapes.

"This puncture should be repeated until the circumference is traversed. In severe cases the bridge between the incisions should be of the same width as the incisions themselves: in cases of less gravity twice or thrice the width. I am in the habit of making about two-thirds of the incision with the right hand and the remainder with the left."

He says that "if carefully performed the operation causes no loss of aqueous or if it does, the fluid is replenished rapidly, so that the anterior chamber is as full after the operation as before. It is important (he tells us), to operate so as to evade this, in order to prevent the additional pain consequent on an empty chamber, and what is more important still, to enable one to complete the incision without endangering the lens."

To this description, A. Nimmo Walker adds the following details: "The operation is more easily performed if the iris is contracted, as the relation of the point of the needle to the lens can be more clearly seen; but, provided that the point is entered well behind the corneo-scleral junction, and kept well up in the anterior chamber, there is no danger of wounding the lens even when the pupil is dilated. The keeping up of the point of the needle is also a safeguard against any sudden movement by the patient, and if this precaution be observed, the operation is free from danger. Indeed, I have never heard of an accident from its use. The number of incisions averages about ten, but varies with the width of the broad needle and with the severity of the inflammation. It is advisable to make the lower incisions first, in order that the bleeding, which should be free, may not obscure the field of operation.

"Except in children, local anesthesia only is necessary, but it must be remembered that, owing to the congestion, longer preparation is required than for cataract or other operations on the uninflamed eye. Usually, the pain is not severe, but if the aqueous be allowed to escape, the sudden alteration in tension causes a twinge. The patients often say that, after the immediate smarting has passed away, they have been relieved of the previous dull aching."

He believes "That kerotomy is based on sound pathological principles, and that its curative action lies in the free drainage of the cornea and the relief thereby afforded to the condition of stasis in the lymphatic channels, or, to express it in language of present-day theory,

in the removal of toxic substances and the substitution of fresh immunizing fluids. This explanation,'' (he states), ''is similar to that given by Axenfeld of the action of paracentesis, but the action of kerotomy is much more powerful as it directly relieves the cornea itself, while it is free from the dangers of paracentesis, i. e., of causing cataract, anterior synechia, and prolapse.

''The obvious criticism of the operation,'' (he tells us), ''is that it is bad surgery to make incisions into the interior of the eye when the exterior is in a condition of inflammation. This criticism,'' (he says), ''applies equally to the paracentesis and Guthrie's operation, and in the present indefinite knowledge of causes of corneal inflammation, and of the virulence or non-virulence of the various organisms found in the conjunctival sac, it is difficult to answer theoretically; but,'' (he goes on to say), ''in eight years' personal experience of the operation, during which time I have seen it performed or performed it myself at least 1,000 times, I have never known a case in which the operation has caused septic infection of the interior of the eye.''

''It has stood the test of time, and now, twenty years after its inception, it remains the operation of choice, indeed almost the only operation employed in these cases at St. Paul's Hospital.''

Kersten, Ferdinand Leopold. A well-known German physician, who devoted considerable attention to ophthalmology. Born in Magdeburg, Nov. 11, 1804, he received the degree of M. D. at Berlin in 1828, his dissertation being ''Nonnulla de Dacryolithis seu potius Rhinolithis.'' He settled in Magdeburg, there became Assessor of the Provincial Medical College, and, a little later, Medical Councillor. He died of some affection of the liver at Carlsbad in 1853.

In addition to his graduation dissertation, Kersten wrote the following: 1. Ueber Steinerzeugung aus der Thränenflüssigkeit (Dacryolithen). (*Hufeland's Jour.*, 1843.) 2. Ueber die Freiwilligen Blutungen aus den Augen (*Rust's Mag.*, 1841.)—(T. H. S.)

Keuchhusten. (G.) Whooping cough.

Keyser, Peter Dirk. A celebrated American ophthalmologist, founder of the Philadelphia Eye and Ear Infirmary and for a long time Dean of the Faculty of the Medico-Chirurgical College of Philadelphia. Born in Philadelphia, Feb. 8, 1835, of German ancestry, he received his education in the arts and sciences at Delaware College, and from 1852 till '54, studied chemistry in the laboratory of Dr. F. A. Genth, Philadelphia. During these two years of chemical study, he published a number of analyses in the *American Journal of Sciences,* which were afterwards reprinted in Dana's *Mineralogy.* He then studied medicine in Germany for four years. Returning to America in 1858,

he practised medicine for a time in Philadelphia, but on the outbreak of the war, he entered as captain of the 91st Pennsylvania regiment. After the battle of Fair Oaks, in which he had been severely wounded, he resigned from the army, and returned to Germany for further study. Entering first the University of Munich, he soon removed to Jena, and there received his medical degree in 1864. After a year of further scientific study in Berlin, Paris, and London, he returned to America, and, after a brief period of military service, settled as ophthalmologist and otologist in Philadelphia.

In 1864 he founded the Philadelphia Eye and Ear Infirmary, the name of which, in 1869, was altered to the Philadelphia Eye and Ear Hospital. In 1868 he gave a course of graduate instruction on the eye. Two years later he delivered "the first regular course of lectures upon ophthalmology ever given in Philadelphia." He soon was made Professor of Ophthalmology at the Medico-Chirurgical College of Philadelphia, and, not long afterward, its dean. In 1887 he was vice-president of the Ophthalmological Section of the Ninth International Congress, and again, in 1890, of the Tenth Congress. He was widely known as the inventor of the Keyser clinical ophthalmoscope. He died of pneumonia at his home, 1832 Arch Street, Philadelphia, April 9, 1897.

Among Dr. Keyser's numerous ophthalmologic articles may be mentioned: "On Persistent Pupillary Membranes;" "On the Measurement of the Prominence of the Eye, with a New Instrument therefor;" "Reports on Cataract Operations;" "On an Instrument for Measuring the Face and Nose for Fitting Spectacle Frames, and a New Scheme for Recording Cases of Refraction."—(T. H. S.)

Kibisitome. (F.) A cystotome or instrument to open the capsule of the lens.

Kidney diseases, Ocular symptoms of. See **Bright's disease, Ocular symptoms of**; also, p. 207, Vol. 1, and p. 5350, Vol. VII, of this *Encyclopedia.*

Kieser, Dietrich Georg. A celebrated German physician, ophthalmologist and botanist. He was also an authority on anatomy and embryology. Born Aug. 24, 1779, at Harbourg, Hanover, he studied at Göttingen and Würzburg, returning to Göttingen in 1804 to receive his degree. His dissertation on this occasion was entitled "Commentatio Physiologica de Anamorphosi Oculi." From 1804 to 1806 he practised at Winsen a. d. Lube. From 1806 till 1812 he was official physician for town and country at Northeim, near Göttingen. In 1812 he was made extraordinary professor of medicine at Jena, but two years later entered the army in his medical capacity, and saw much

service in the military hospitals at Paris, Leyden, Liège, and Versailles. After the war he taught again at Jena and held many official positions. In 1836 he was president of the Fourteenth Convocation of German Scientists and Physicians at Jena. From 1831 till 1847 he was Superintendent of the Medico-Chirurgical and Ophthalmiatric Private Hospital. In 1854 he celebrated the fiftieth anniversary of his doctorate, on which occasion he was awarded the "Ehrengrad" of Doctor of Philosophy. He died Oct. 11, 1862.

In addition to works of a general character and the thesis above mentioned, Kieser wrote the following: 1. Ueber die Metamorphose des Thier-Auges. (Himly und Schmidt's *Ophth. Bibl.,* II, 3, 73-124, 1804.) 2. Clerophthalmos. (Himly und Schmidt's *Ophth. Bibl.,* III, 3, 79-94, 1807.) 3. Ueber die Natur, Ursachen, Kennzeichen und Heilung des Schwarzen Staares. (Göttingen, 1811.)—(T. H. S.)

Killian's operation. Excision of the anterior wall of the frontal sinus, removal of the diseased tissue, and formation of a permanent communication with the nose. See **Cavities, Neighboring.**

Kilowatt. The electric unit of power or activity in mechanics—one thousand watts—1.3406 horse-power.

Kindergarten, Ocular hygiene of the. The canons that regulate the use of the eyes during the student life of children in general govern the earliest forms of instruction. The younger the child the less use he should make of his eyes, is a safe generalization. This subject is fully ventilated under various captions in this *Encyclopedia* but especially on p. 3204, Vol. V, as well as under **Hygiene of the eye; Illumination** and **Myopia.** It may be said, finally, that there is little to complain of, from the visual standpoint, in the occupations and recreations of the modern kindergarten.

Kindergarten test card. ILLITERATE TEST CHART. OBJECT TEST CHART. See p. 2022, Vol. III, and p. 4653, Vol. VI, of this *Encyclopedia.*

Kinderlähmung. (G.) Infantile paralysis.

Kinemacolor. This term has been applied to stereoscopic life-motion pictures, reproduced in the actual tints and hues of nature, without any artificial means of coloring.

Invented by Charles Urban and G. Albert Smith, kinemacolor pictures were exhibited for the first time in London, England, in February, 1909. They require for their production apparatus similar to that used in ordinary black and white kinematograph work, but with certain fundamental differences.

The kinemacolor camera makes thirty-two exposures a second and has a rotating color-filter between the lens and shutter. This color filter consists of a revolving wheel containing two narrow blank sectors,

and also two large sectors of colored sheet gelatin, one red and the other green. It is so geared that exposures are made through the red and green sectors alternately.

The kinemacolor film consists of pairs of images. These are really the records of the red and green in the original objects photographed, and are called the ''red'' and ''green'' pictures respectively. The film itself is colorless. Colors appear only on the screen after the film has been passed through a special kinemacolor projector. This exposes 2 ft. of film (or 32 pictures) per second, and has between the condenser and the gate or fire-proof shield a rotating color-filter similar to that already described. The film is threaded on to the projector in such a way that a ''green'' picture shows when the green filter is between the condenser and the gate.

Consider the case of a red flower with green leaves. In the ''green'' pictures of the film the red flower appears dark and the leaves light. On the screen the flower appears slightly green, as very little or no green light can fall where its image should be projected on the screen. On the other hand, the leaves appear bright green. One thirty-second of a second later, a ''red'' picture takes the place of the ''green'' one, and simultaneously the red filter replaces the green one. This time, the flower is well illuminated with red light, but the leaves only slightly so; for in the ''red'' picture the flower is light and the leaves dark. The pictures follow each other at the rate of 32 every second, and the resultant effect observed is that of a red flower with green leaves.

Colors other than red and green can also be reproduced. The source of yellow is the orange-red of the red filter; while the green of the filter is of such a shade that in the light of the projection disc it gives the impression of a pure and neutral blue tint. A further important factor is the light in the auditorium before a picture display, this generally being far yellower than the illumination of the screen.—(*Standard Encyclopedia.*)

Kinematics. The science of motions.

Kinematograph. See **Cinematograph.**

Kinescope. An instrument for measuring ocular refraction, in which the patient observes a fixed object through a slit in a moving disk.

Kinescopy. This is a form of subjective measurement of the refraction introduced by Holm (*Annales d'Oculistique,* Vol. 127, p. 241) and based on Scheiner's experiment (q. v.). It is not, however, a reliable method.

Kinetograph. A contrivance for taking a series of pictures of rapidly moving objects in quick succession, for use in the kinetoscope. See **Cinematograph.**

Kinetoscope. An instrument for effecting the combination of axes of different radii in one curve. A form of *zoetrope.*

King's evil. Scrofula.

Kingship, Blindness as a disqualification for. In numerous lands and ages blindness has been regarded as an absolute bar to kingship. Thus, according to Ferraras, Witiza, the Visigoth, put out the eyes of Theodofred, with the object of rendering him ineligible to the throne. Alboquerque, with a similar view, put out the eyes of fifteen kings of Portugal. Some very important monarchs, however, have been absolutely blind. See, in this *Encyclopedia*, **Basil the Third; Bela the Second, King of Hungary; Dandolo, the Blind Doge of Venice; Isaac Angelus, Emperor of the East; John, King of Bohemia; Sha Allum**; and **Theodore, Emperor of Epirus.**—(T. H. S.)

Kings pugh. One of the numerous forms of tinted glass now on the market, intended to protect the eyes from glare or from specially injurious rays of light. Spectograms comparing this with other kinds of protective glass will be found in the *Trans. Oph. Sec. A. M. A.*, p. 256, 1915.

Kipp, Charles John. A well-known German-American ophthalmologist. Born at Hanover, Germany, in Oct., 1835, he came to the United States at the age of nineteen. Here he received his medical degree at the College of Physicians and Surgeons in the City of New York in 1861. He served in the army from 1862 until considerably after the close of the war; being Acting Assistant Surgeon in 1862, Assistant Surgeon in 1863, Major and Surgeon in 1864, Brevet Lieutenant-Colonel and Surgeon in 1865. In Nov., 1867, he resigned.

In 1869 he settled in Newark, N. J., as an ophthalmologist. He founded the eye and ear clinic at St. Michael's Hospital and the Newark Eye and Ear Infirmary. He was Chief Surgeon of the Newark Eye and Ear Infirmary and Consulting Surgeon to the German, St. Barnabas, Bayonne, Mountainside, and Somerset Hospitals. In 1885 and 1886 he was President of the New York Ophthalmological Society, in 1886 of the New Jersey Medical Society and, from 1901 till 1906, of the New Jersey State Tuberculosis Sanitarium. In 1907 and 1908 he was President of the American Ophthalmological Society, President of the Otological Society, and Vice-President of the A. M. A. He was also a member of the Heidelberg Ophthalmological Congress.

According to Peter Callan, of New York, he was the first to recognize the frequent connection between optic neuritis and otitic thrombosis of the lateral sinus, and was the first to report in America a case of cysticercus in the ocular conjunctiva. Harry V. Würdemann said of him that one of Kipp's notable achievements in science was his

discovery of a form of eye disease caused by malaria, to which he was first to call attention, in the early nineties.

Dr. Kipp was a frequent contributor to periodical literature, and also to the medical encyclopedias. Perhaps his most important writing is the section on diseases of the ear in the *International Handbook of Surgery*. Among his ophthalmic writings we may mention the following: 1. On Gonorrheic Irido-Choroiditis. (*Med. Rec.*, N. Y., 1880, xvii.) 2. On the Significance of the Development of Optic Neuritis in Cases of Purulent Inflammation of the Middle Ear. (*Arch. Otol.*, 1885.) 3. A Case of Double Vascular Exophthalmos; Recovery under Intermittent Compression of the Right Carotid Artery and the Internal Use of the Iodide of Potassium; Cocaine Conjunctivitis. (*Tr. Am. Ophth. Soc.*, 1888-90.) 4. Three Cases of Transient Bilateral Horizontal Nystagmus Occurring in Connection with Purulent Inflammation of the Middle Ear. (*Tr. Am. Otol. Soc.*, 1887-90.) 5. A Case of Acute Purulent Inflammation of the Middle Ear with Double Optic Neuritis, but without Tenderness or Swelling of, etc. (*Tr. Am. Otol. Soc.*, 1891.) 6. A Case of Bilateral Recurrent Inflammation of Ténon's Capsule in Connection with Profound Mercurial Poisoning. (*Tr. Am. Ophth. Soc.*, 1891-3.)—(T. H. S.)

Kirchhoff, Gustav Robert, (1824-87), German physicist. He became professor in Berlin University in 1874, and distinguished himself in the sciences relating to the mechanics of heat, optics, and especially of spectrum-analysis. See **Spectrum analysis.**

Kirrhonose. (F.) Morbid products having a yellow color.

Kirschlorbeerwasser. (G.) Cherry-laurel water.

Klaffender Staar. (G.) Dehiscent cataract.

Klatsch preparation. A cover-glass preparation made by pressing a cover-glass on a plate-culture of bacteria.

Klebs-Loeffler bacillus. See p. 3998, Vol. VI, and p. 3113, Vol. IV, of this *Encyclopedia;* as well as **Bacteriology of the eye.**

Kleid. (G.) A covering; investment.

Kleiner Augenbrauenmuskel. (G.) Corrugator supercilii.

Kleiner Augenknoten. (G.) Nasal nerve.

Kleines Auge. (G.) Ocellus.

Kleinhans, Joseph. A celebrated, blind Austrian sculptor. He was born in the Tyrol, and at the age of five was blinded by the smallpox. Soon afterwards he began to carve little statues out of wood, and, when eleven years old, produced a figure of Jesus of a high degree of excellence. The result was a long period of careful instruction under Nissl. All through life he showed a marked predilection for the Saviour as a subject of his art, and, in fact, he is declared to have

cut more than 400 statues of Jesus. A bust of the Emperor, Francis Joseph was his last production. He died at Nauders, July 10, 1853. —(T. H. S.)

Kleinhirn. (G.) Cerebellum.

Kliniks, Eye. See **Ophthalmic hospitals and clinics.**

Klinoskop. (G.) Clinoscope.

Kloakengas. (G.) Sewer gas.

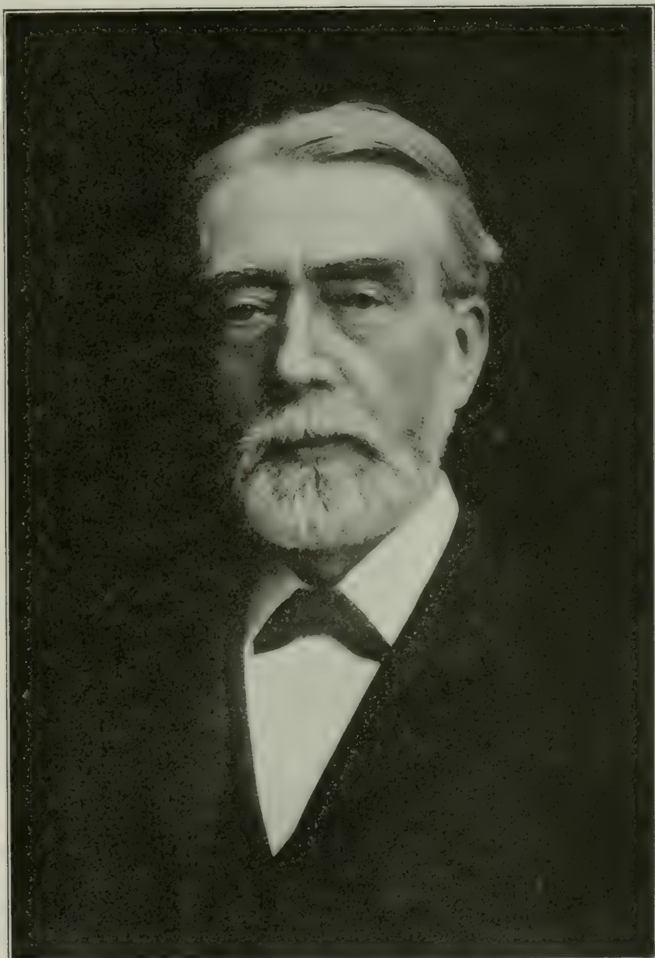
Klumpichter Staar. (G.) Grumous cataract.

Knapp, Hermann Jakob. A celebrated German-American ophthalmologist and oto-laryngologist, founder of the Ophthalmic and Aural Institute at New York, founder and for a long time one of the editors of the *Archiv für Augen- und Ohrenheilkunde,* and of the English editions, the *Archives of Otology* and the *Archives of Ophthalmology.* Hermann Knapp was born of wealthy parents March 17, 1832, at Dauborn, Hesse-Nassau, Germany. His father was Johann Knapp, member of the German Reichsrath. For a time the subject of this sketch desired to be a poet, but, later, at his father's request, he turned his attention to medicine, especially ophthalmology. After the usual training in the humanities, he began to study medicine—i. e., in 1851, the very year in which the newly-discovered ophthalmoscope was announced to the world. After a number of years at München, Würzburg, Berlin, Leipzig, Zürich, and Giessen, he received his degree in 1854 at the university last mentioned. He then proceeded to study ophthalmology at Paris, London, Utrecht, and Heidelberg, at length becoming assistant to A. von Graefe. In 1860 he qualified as privatdocent for ophthalmology in Heidelberg, and, five years later, was appointed full professor. He was also founder of the first University Eye Clinic in Heidelberg.

For three years only, however, he filled the Heidelberg chair, for, in 1868, he removed to New York City, where he at once founded a private clinic for diseases of the eye and ear. This clinic was shortly afterward incorporated as the Ophthalmic and Aural Institute. It was open to rich and poor alike, and became the greatest institution of its kind this side the Atlantic.

The history of this institution is a very important part of the life of Hermann Knapp; it is, therefore, given here. The New York Ophthalmic and Aural Institute was at first located in the building at No. 46 E. 12th St.—a building bought and equipped by Hermann Knapp himself. The beginnings of the Institute were slow. During the first year, only 1,828 patients were received and treated. In recent years, however, the number has amounted sometimes to as many as 17,000, while at the close of September, 1913, the aggregate number

(of charity patients only) was over 420,000. More than 55,000 operations "either of critical or of substantial character" had been performed, "of which a trifle over 95½ per cent. showed either good or



Hermann Knapp.

perfect success." In a certain year, 116 operations for cataract showed only one failure.

From the very beginning, The New York Ophthalmic and Aural Institute was an educational, as well as a clinical, affair. Two kinds of certificates were, and still are, issued: certificates of mere attendance and certificates of proficiency. The latter were, and still are,

issued only upon the passing of the most rigid theoretical and practical tests. Those who have studied at this institute have settled in various portions of the country, and many have become distinguished ophthalmic operators, authors and teachers. The following is a list of those "who have been connected with the Institute either as surgeons or as assistant surgeons":

Jos Aub	W. B. Marple	Selina Bloom
E. Gruening	J. Bettman	C. Ap. C. Jones
Thos. R. Pooley	M. Toplitz	E. Schalck
Xen. C. Scott	F. T. Smith	J. A. Jackson
Chas. S. Turnbull	S. de Jager	J. Wolff
J. A. Steurer	A. Weiland	J. J. Shea
R. Gebser	C. H. May	E. Harlow
A. Schapringer	C. Koch	M. J. Ballin
F. A. Munson	F. H. Weir	F. E. Ruppert
R. Sattler	H. K. Porter	E. Connor
A. Alt	H. H. Tyson	D. T. Marshall
C. Williams	J. M. Mills	A. Mund
R. O. Born	W. A. Holden	M. Cohen
B. Bettman	C. E. Finlay	G. H. Cocks
R. C. Brandeis	A. Duane	E. J. Marsh
Hugh A. Hart	W. Vulpius	C. P. Bennett
W. C. Ayres	C. B. Carter	E. Török
C. A. Le Boutillier	A. N. Alling	G. Tieck
F. E. D'Oench	E. B. Coburn	O. Schirmer
Rosa W. Strauss	Arnold Knapp	G. H. Grout
J. E. Weeks	J. B. Lynch	M. I. Schoenberg
J. S. Hopkins	J. Guttman	O. Diem
J. H. Shorter	C. Mund	
J. B. McMahon	R. Jordan	

In course of time No. 44 E. 12th St. was purchased by Dr. Knapp and added to No. 46.*

After the death of Dr. Knapp the Institute was moved to the southwest corner of 57th St. and Tenth Ave., its name being changed at the time to "The Knapp Memorial Eye Hospital"—the name which it still bears. The advantages of the new location, as stated by the Secretary, are threefold: "First, it is very accessible and lies at the intersection of two broad streets, permanently insuring light and air.

*In fact the frequent financial deficits of the Institute were always defrayed by Dr. Knapp, the total amount thus paid by him amounting to more than sixty thousand dollars.

Hermann Knapp Memorial Eye Hospital.

Second, as its location is in the midst of a large tenement house population, where there is no special hospital for the treatment of diseases of the eye, it affords enlarged opportunities for continuing the charitable work of the dispensary which has, since its beginning, treated over 420,000 poor patients. And, third, its proximity to the College of Physicians and Surgeons will greatly facilitate and improve the systematic instruction to its third-year students in ophthalmology.'' The building is modern, conveniently arranged, and fireproof. In addition to a basement containing the kitchen, laundry, storerooms, and janitor's quarters, there are seven large, well lighted stories, devoted to uses as follows: First and second stories.—The out-patient and dispensary department. Teaching rooms. Third, fourth and fifth stories.—The in-patient, or hospital, department. Sixth floor.—Accommodations for nurses. Seventh floor.—Laboratory. Operating room, with adjoining rooms for etherizing and sterilizing. Rooms for domestics. Above the whole is a roof garden.

Under the supervision of the founder's son, Dr. Arnold Knapp, the Knapp Memorial Eye Hospital continues to perform the useful and merciful services of the old Ophthalmic and Aural Institute—a splendid tribute to departed genius.

In 1869 Dr. Hermann Knapp founded, together with Moos, the *Archiv f. Augen- and Ohrenheilkunde,* which, ten years later, was divided into the *Archiv f. Augenheilkunde* (edited by Knapp and J. Hirschberg, Berlin), and the *Archiv f. Ohrenheilkunde* (edited by Knapp and Moos). An English edition of each of these three periodicals was published from the very beginning, and, after the division of the parent journal, Knapp continued in charge of the English edition of both the resultant publications. The original papers in the English editions appear in the German periodicals either in full or in more or less abridged translations, and *vice versa.*

In 1882 Knapp became professor of ophthalmology in the Medical Department of the University of the City of New York—a position which he held till 1888—when he accepted the like chair at the College of Physicians and Surgeons, being the Medical Department of Columbia University. In 1903 he was made emeritus professor at the latter institution.

For the last few years of his life, the apparently indefatigable Knapp, he who had always been so vigorous and energetic, began to feel that his powers were failing. He, therefore, like the calm, courageous person that he was, began to set his house in order, preparing for the journey of no return. He died of pneumonia at his

country residence, Mamaroneck, N. Y., May 1, 1911, being 79 years of age.

A memorial fund was established by the Section of Ophthalmology of the American Medical Association, known as "The Hermann Knapp Testimonial Fund." This fund, each year, supplies an honorarium "to any member of the section or to any distinguished man who comes before the section, as its guest, by special invitation of the officers and executive committee of the section, and presents an especially meritorious and valuable address or thesis bearing upon ophthalmologic practice, which may be classed under one of the following heads: First, such as may contain and establish positively new facts, modes of practice, or principles of value; second, such as may contain the results of well-devised original experimental research, and third, such as present so complete a review of the facts on any particular subject as to enable the writer to deduce therefrom conclusions of importance."

An appropriate sum is, further, being set aside each year for a period of five years, for the purpose of procuring a suitable bust of Dr. Knapp, the bust to be placed in a location selected by a committee representing the section.

The fund was raised by voluntary contributions from the members of the section.

Knapp was a medium sized man, of firm and elastic carriage, in fact of somewhat military bearing. His beard was blond, till grizzled by advancing age; his complexion florid; and his eyes (as the writer remembers them) like clear, blue stones. There was always a faint suggestion of a smile at the corners of his mouth—a trait which shows in his portraits. He would often speak out quickly and impatiently. Even then, however, he almost always followed any retort or rebuke by something of a kindlier nature, and the writer has never known of anyone who took a deep and abiding offense at even the sharpest words of Hermann Knapp.

As an operator, Knapp was deliberate and yet rapid, as accurate as a fine machine, and the very acme of coolness and steadiness. There was, too, a methodical economy about his operations that made them seem like masterpieces of fine art; never a stroke too many, not even a superfluous turning of a finger. As a teacher he was quiet, terse, unobtrusively illuminating. A trace of German accent served merely to pique the attention of his hearers. A master of ophthalmologic history, he employed his colossal knowledge of the deeply-respected past with the greatest care and good judgment, bringing it in by bits, not by wearisome cart-loads, and only where it had some practical application; where, for example, it set a finer point upon

some sentence, or afforded a useful contrast to the methods in use at the present day. The writer recalls with pleasure a lecture on iritis which he heard more than twenty years ago delivered by Knapp at his Institute, in connection with a case there present. Never till then had he thought how valuable and, in the highest meaning of the word, how practical, the history of a subject could be made, even in connection with its teaching to undergraduates. Then, too, the scrupulous intellectual honesty of the man shone round him like a radiance, carried conviction, and won the hearts as well as the minds of his hearers. As an editor, he was cautious, accurate and painstaking, intolerant of bluster and of brag, of slipshod statement, or loose, inaccurate English. He is said to have had many an acrimonious correspondence with offended contributors. No wonder!

As an inventor of ophthalmologic instruments, Knapp stood at the head of the list in this country. Who does not at once recall Knapp's improved lid forceps; Knapp's roller forceps for the treatment of trachoma; Knapp's needle-knife for the discission of secondary cataract and the division of incarcerated capsule; Knapp's head-rest for the Helmholtz ophthalmometer; Knapp's ophthalmotrope; his ophthalmoscope, his apparatus for demonstrating the course of the rays in astigmatism, his ocular speculum, his cystotome, his operating chair? And the salient quality of each and every one of Knapp's contrivances was—practicality. Each of these instruments is described and illustrated under its appropriate caption in this *Encyclopedia.*

In fact there was very little fuss-and-feathers about Hermann Knapp, no ostentation, no parade. Straight to the point he went, and there an end. Hence he would never listen to a proposal for any kind of dinner, testimonial, or celebration in his honor. Then, too, in a private letter from Dr. James A. Spalding, of Portland, Me., is the following: "He told me about 1878 that he came to New York with a big pile of letters from all over Europe to leading New York Germans. 'But,' said he, 'when I sighted New York bar and knew that I was near the second largest German city in the world, I tore to bits every letter that I had and cast them into the waters. I hired a house, rented my Institute, and went to work: an utter stranger. In my first year I made $500.00, second $2,000.00, and, after that, I went up as high as $20,000.00, and, still later, much higher.' "

Another striking quality of the personality of Knapp was his untiring industry (at which I have already hinted) and his absolute thoroughness. Many are the stories that are told in illustration of this characteristic. Thus, Dr. William H. Dudley, of Los Angeles, has kindly sent the following: "To show his intense interest in patho-

logical conditions, and to what pains he was willing to go for them, in 1893, when I was his 'resident assistant,' a patient from up the state was seen by him in consultation, also by a number of others. All were much interested in the patient (for the case was not exactly clear to any of them) who died rather suddenly in the upper part of the city. Dr. Knapp succeeded in obtaining consent for autopsy. It was late in the fall, and the autopsy was set for 4:30 a. m. Knapp had several miles to go, but was there on time, and the autopsy performed, but the others interested (who were also invited) found the hour too early for them, and were not present. This was at a time when the Doctor was no longer a young man."

Precisely the same quality—that of indefatigability—is further illustrated by yet another anecdote, which has its grotesquely amusing side, and which is also reported by Dr. Dudley: "A child, under the care of Dr. Knapp, died of some obscure condition, the clearing up of which necessitated the obtaining of the child's head. Dr. Knapp's appeals to the mother for a post-mortem examination were of no avail. So he went to the undertaker's and succeeded in getting the men in charge of the rooms to leave the place for a short time, and when the doctor left, he had the head of the child in his handbag. When the mother came to take the body away, she insisted on taking another view, which the undertaker was loath to allow; however, the mother insisted, and the coffin was opened. Great lamentations followed, and the doctor was immediately visited. The mother laid much stress on the fact that she was a widow, a *poor* widow, with great difficulty in getting on in the world, all of which increased her grief at the loss of the head of the corpse. The Doctor stated to her that it was absolutely necessary in the interest of science that the head should be examined, and that there was nothing else to be done. As this statement did not satisfy the mother, a roll of greenbacks was suggested, and strange as it appears, they were accepted, and the profuse lacrimation ceased. But the Doctor's troubles did not cease here with this mother, for her grief was prone to return at intervals, at which times they were only relieved by a visit to the doctor. This happened a considerable number of times, and, if I understood the Doctor aright, this was by far the most expensive autopsy he ever performed."

Still another side (or perhaps two sides) of the character of Knapp is shown by the following lines from Dr. Charles H. May, of New York: "I also assisted the late Hermann Knapp. His character was entirely different from that of Agnew. He was German and somewhat brusque, but when you knew him well, as I did, you realized that his brusqueness was not intended to be affectation but was merely

a mannerism, and that under the surface he was kind and considerate. His lectures at the College were very often handicapped by details entirely too deep for the student to grasp. Thus his assistants often got more out of the lectures than did the students, for the lectures were always interesting to ophthalmologists. I knew no one whose experience was so profound and upon whose judgment I would rely so much and marvel at to such an extent. Indeed, the prognoses which he gave in cases of injuries and serious ocular affections were usually borne out by subsequent developments. Knapp rarely indulged in humor in his lectures; he was always stern. The only joke I ever knew him to engage in during his lectures was in connection with dacryocystitis. Regularly, after he had finished the discussion of the treatment of this affection, having frequently alluded to the fact that the results were not always satisfactory, he would say to the students: 'The best treatment, after all, is to send such cases to your enemies.' "

The character of Hermann Knapp was as free from envy and jealousy as that of any child. Yet the competition, or, rather, emulation, between the Ophthalmic and Aural Institute (conducted by Knapp) and the New York Eye and Ear Infirmary (conducted by the almost equally celebrated Noyes) was intense in the extreme, and about this state of affairs many (often amusing) stories are told.

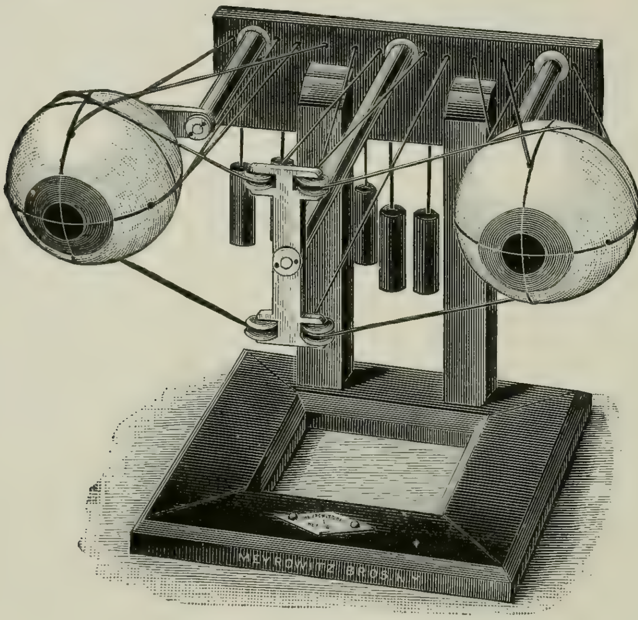
And, speaking of generosity, Knapp was generous in yet another sense. Hospitality, money, kindly assistance of various sorts, were always to be had by his fellow ophthalmologists from the gruff, short-spoken, but tender-hearted Knapp. Thus, the following anecdote is reported by one of the older American ophthalmologists, who, however, most earnestly requests that his name be not mentioned in connection with the matter. "I," said he, "had been meeting with many reverses, and yet had begun to try to build a house. Times were hard, and I was on the point of failing, when kindly, tender-hearted Hermann Knapp, who owed nothing whatever to either me or mine, hearing of my plight, offered to lend me any amount of money up to $5,000.00, without one cent of interest. I shall never forget Hermann Knapp. He was like an older brother to me in various ways, and I appreciate the matter all the more because he owed me nothing. May his memory be blessed."

And so say all of us. For Knapp himself was a blessing to all who came within the sphere of his influence—both to the ophthalmologic profession and also to the laity. Who can estimate the value of this man's services to the poor of Greater New York—services given with a kind of joyous enthusiasm for more than forty years, wholly without money and without price? And who can appraise those still more

enthusiastic and even more inestimable services which Knapp for so long rendered as a teacher of teachers, a shaper and developer of operators and writers? Though he himself is gone, his influence is widening. He was, in truth, a man among ten thousand—a fact that is growing to greater and greater distinctness, in the minds of the older ophthalmologists of this country, as the years glide by.

A complete bibliography of Hermann Knapp would include, it is said, about 300 items. For the *Archives* alone, he wrote some hundred and fifty articles, while more than fifty important contributions from his pen were published in the *Transactions of the American Ophthalmological and Otological Societies.* A complete bibliography of his ophthalmic writings only, would fill some forty or fifty pages of this *Encyclopedia*, for some of the titles are rather long. We append, therefore, hereunder, a list of only a few of the more important ophthalmic writings of Hermann Knapp: 1. Die Krümmung der Hornhaut des Menschlichen Auges. (*Habilitationsschrift,* Heidelberg, 1859.) 2. Ueber die Lage und Krümmung der Oberflächen der Menschlichen Kristalllinse und den Einfluss ihrer Veränderungen bei der Accommodation auf die Dioptrik des Auges. (*Arch. f. Ophth.*, 1859, vi, 2.) 3. Die Geschichtliche Entwicklung der Lehre vom Sehen sowohl des Gesunden als des Kranken Auges. Ein Populär-Wissenschaftlicher Vortrag. (Wiesbaden, 1862.) 4. Jahresbericht über die Augenheilanstalt zu Heidelberg. (Heidelberg, 1863-8.) 5. Ueber Krankenhäuser, Besonders Augen-Kliniken. (Heidelberg, 1866.) 6. Die Intraocularen Geschwülste nach Eigenen Klinischen Beobachtungen und Anatomischen Untersuchungen. (Karlsruhe, 1868.) 7. Embolic Diseases of the Eye. (*N. Y. Med. Jour.*, 1869, X.) 8. Remarks on Some Practical Points Concerning Cataract Extraction. (*Tr. Am. Ophth. Soc.*, 1865-'71, I.) 9. Large Orbital Sarcoma, Removed with Preservation of the Eye-Ball; Death from Acute Nephritis; Autopsy. (*Arch. Ophth. and Otol.*, 1876, V.) 10. The Removal of Foreign Bodies from the Interior of the Eye. (*Ibid.*, 1878-9, VII.) 11. Cocaine and its Use in Ophthalmic and General Surgery (*Archives of Ophthalmology,* Dec., 1884; in book form, Messrs. G. P. Putnam's Sons, New York and London, 1885.) 12. Dioptry or Dioptric? (*N. Y. Med. Jour.*, 1886, XLIV.) 13. Experiments on the Action of Bacteria on Operations of the Eye. (*Arch. Ophth.*, 1886, XV.) 14. On Cataract Extraction without Iridectomy. (*Arch. Ophth.*, 1887, XVI.) 15. Report on a Second Series of One Hundred Successive Cataract Extractions without Iridectomy. (*Arch. Ophth.*, 1889, XVIII.) 16. Orbital Optic Neuritis, Including Alcohol and Tobacco Amaurosis. (*Ibid.*, 1891, XX.) 17. Operations Usually Performed in Eye-Surgery. (Norris and Oliver's *System of Diseases of the Eye,* 1898, III.)—(T. H. S.)

Knapp's ophthalmotrope. This is an ingenious apparatus for demonstrating the movements of the eyeball and the action of the different muscles which produce them. Each muscle is represented by a cord and weight running over a pulley. The elevation or depression of the weight acts upon and determines the rotation of the globe. Thus, by single and combined movements of the weighted cord the normal balance and the abnormal relations of the various extrinsic muscles, in divergence, convergence, sursumvergence, etc., may be studied and demonstrated. The accompanying figure furnishes a good idea of the practical uses of the instrument.



Knapp's Ophthalmotrope.

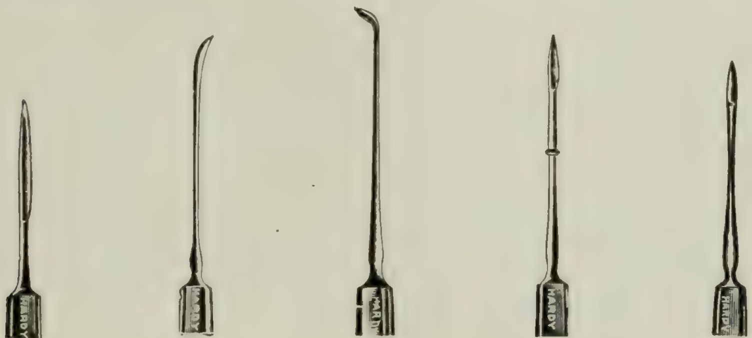
Knapp's peripheral capsulotomy. An operation in which the capsule is opened along the upper portion of the equator of the lens, parallel with and close to the section of the eyeball.

Kneass, Napoleon, Jr. An American who published, in 1867, an improved form of embossed literature for the sightless. See **Alphabet for the blind.**

Knife-needles. Many of these instruments are described (with figures) under **After-cataract** and **Discission,** and a few others under **Knives, Ophthalmic**; and **Cystotome.** It may be said here that in the operation of discission the models of Knapp, Hays and Ziegler are each excellent.

G. B. Jobson, Jr., and H. P. Hammond have invented an iridotomy knife (*The Ophthalmic Record,* Sept., 1908, p. 448) which is similar to a cystotome with a large blade set at an angle to the shaft. The blade is made very thin, broad and sharp-pointed, and is as long as the distance from the posterior surface of the cornea to the iris will permit.

A. J. Erwin suggests a knife for secondary cataract that is about the size of the smallest discission needle, curved about 50 degrees on both the edge and the flat, with both edges and point sharp. Its action is corkscrew-like; by a rotary motion one may tear the capsule or draw it to the corneal margin and extract it. (*Trans. Section of Oph. A. M. A.,* 1896, p. 112.)



a b c d e

Fig. 160

Knife-Needles. a. Pagenstecher's, b. Sichel's, c. Jobson's iridotomy, d, Knapp's (with stop), e. Knapp's.

A. G. Heyl's discission needle is bent at an angle of 15°; it is 11 mm. long and 5 mm. broad. (*Am. Jour. Med. Sciences,* Aug. 6th, 1885.)

C. Pascheff (*Ophthalmic Review,* March, 1905, p. 70) describes his iridotome which consists of two lancets gliding one within the other. One terminates with a kind of cutting hook, which is intended to go below the iris; the second ends with a blade destined to cut through the part of the iris included between the two.

M. H. Post (*Amer. Jour. of Oph.,* May, 1908, p. 129) describes an instrument, whose blade, 6 mm. long and 1¼ mm. wide at its widest part, about 3 mm. from the point, has its back straight and dull, and a sharply-rounded cutting edge extending its entire length. The shank is cylindrical and of a diameter sufficient to prevent the escape of aqueous during the operation.

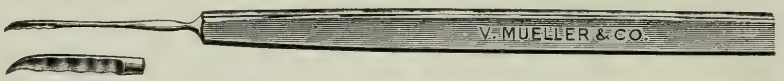
John E. Weeks has invented a discission knife, a curved knife-needle, shaped something like a sickle. A hooked extremity is formed by a curve which extends from the middle of the blade to the point.

The blade is about ⅔ mm. in width, and the shaft is just large enough to fill the opening made by the blade when the knife is properly entered. The concave edge and the point of the blade are rendered as sharp as possible; the convex edge of the point, for one millimeter up, is also sharpened. (*Trans. Am. Oph. Soc.*, 1895, p. 398.)

F. Buller's double needle to facilitate discission operation consists of two needles, 0.25 mm. in diameter and very sharp, placed exactly parallel in one handle. Their object is to transfix and steady the dense capsule while the discission is performed with the knife needle. (*Trans. Amer. Oph. Soc.*, 1899, p. 563.)

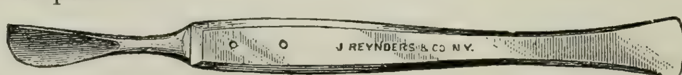
Knife, Ophthalmic. See **Knives, Ophthalmic.**

Knives, Ophthalmic. These instruments will, with barely an exception, be found described and pictured under operative and other appropriate headings. See, in particular, **Cataract , Senile**; **Chalazion**; **Blepharoplasty**; **Knife-needles**; **Glaucoma**; **Entropion**; **Discission**; **Pterygium**; **Canaliculus knives**; and **After-cataract.** A few cuts of ophthalmic knives, not readily found or not depicted elsewhere in this *Encyclopedia*, are figured in this text.

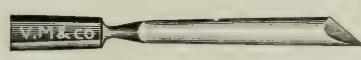


Frank Brawley's Knife for Pupillary Membrances.
A, Natural size. B, Enlarged to show detail of blade.

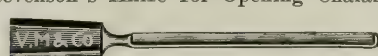
Frank Brawley's (*Ophth. Record*, March, 1912) *bread-knife cystotome* is of the same size as Zeigler's knife, but the point is more strongly curved and is very sharp, so that it may easily be stabbed through the iris and lens capsule. The remainder of the blade is sinuous, the better to hold the iris fibers while the incision is being made, by a sawing motion. The knife should be introduced somewhat as though it were a sharp hook, as the curved point makes direct introduction impossible.



Green's Entropion Knife.



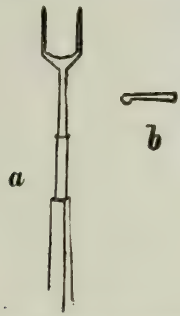
Stevenson's Knife for Opening Chalazion.



Black's probe Pointed Cataract Knife for Enlarging the Primary Corneal Incision in the Extraction of Cataract.
See p. 1718, Vol. III, of this *Encyclopedia*.

Deutschmann's Double-edge Knife for Sclerotomy, and in Operating on Detached Retina.

Young's Ptergium Knife, Right and Left.

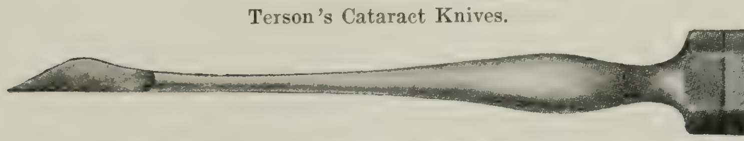


Lohlein's Knife for Marking off the Flap in Corneal Transplanation.
a, Showing two blades; *b*, Either blade from the side.
See p. 3493, Vol. V, of this *Encyclopedia*.

Payne's Pterygium Knife.

La Force's Foreign Body Knife Spud.

Terson's Cataract Knives.



Knife for dividing Membrane Obstructing the Pupil after Cataract Extraction. (Post.)
See p. 120, Vol. I, of this *Encyclopedia*.

Nicati's Cataract Knife.

Knochen. (G.) Bone.

Knochenähnlich. (G.) Osseous.

Knochenartig. (G.) Bony.

Knochenbildungsheerde. (G.) A centre of ossification.

Knochenfrass. (G.) Caries.

Knochengewächs. (G.) Exostosis and osteoma.

Knochenhaut. (G.) Periosteum.

Knochenwurm. (G.) Actinomyces.

Knollenblätterschwamm. (G.) The poisonous mushroom *Agaricus phalloides.*

Knopf. (G.) A knob or button. In anatomy, a condyle; in botany, a tubercle.

Knorpel. (G.) Cartilage.

Knotenpunkt. (G.) Nodal point.

Knot grass. *Polygonum aviculare*, called by Pliny "sanguinaria." In ancient Greco-Roman times, sanguinaria was employed as an ocular analgesic. It had, of course, no analgesic effect.—(T. H. S.)

Knot, Surgical. See **Sutures.**

Koch, Robert, (1843-1910). This eminent German bacteriologist was born at Klausthal and practised medicine at Hanover and elsewhere. His researches in microscopy and bacteriology led to his discovery in 1882 of the *bacillus tuberculosis.* In 1883 he was appointed leader of a German expedition sent to Egypt and India in quest of the cholera germ. In 1885 he was appointed professor at Berlin. He published many works on bacteriology and on bacterial diseases; and was, with John E. Weeks, the discoverer of the Koch-Weeks bacillus.

Kochsalz. (G.) Table salt.

Koch's bacillus. Bacillus tuberculosis. See **Bacteriology of the eye.**

Koch's tuberculin reaction. According to E. E. Irons (Wood's *System of Ophthalmic Therapeutics*, p. 200) the first bacterial reaction for the diagnosis of tuberculosis was developed by Koch, who found that a hypodermic injection of a small amount of tuberculin in a case of tuberculosis was followed in a few hours by a rise in temperature, headache, malaise and anorexia. The method with restrictions as to dose, etc., has been widely practised, and has come to be regarded as the standard for estimating the accuracy of other tests.

Briefly, the procedure is as follows: The patient is carefully examined for physical evidence of tuberculosis. Cases of active tuberculosis or suspected cases in which high fever is present should not be subjected to the test. If possible the subject of a tuberculin test should be at rest in bed during the period. In suitable cases the temperature

is taken every two hours for a period of two days. A solution of old tuberculin in water to which .5 per cent. carbolic acid has been added is prepared so that 1 c. c. of the solution contains 1 mg. of tuberculin. In the afternoon, or in slightly febrile cases, in the evening, 1 mg. of tuberculin is given hypodermically. A positive reaction is signalized by a rise in temperature, headache and malaise. In severe reactions, there may be chill, nausea, vomiting, and severe prostration, the symptoms persisting for 24 hours or more. Associated with the constitutional symptoms, there is frequently marked redness, swelling, and tenderness at the site of the injection, and where the lesion is accessible to observation, as in the eye, injection of the vessels and increased exudation.

In cases showing no reaction, a second injection of 1 mg., or after waiting a day 2 mg., may be given. If there is then no reaction, a further dose of 5 mg. may be used. If no reaction follows, the test is regarded as negative. Most clinicians prefer not to use diagnostic doses larger than 5 mg. on account of the danger of severe reactions, with rapid extension of the tuberculous process which has occasionally followed the use of large doses.

In cases of undoubted tuberculosis the reaction has been obtained in from 95 to 100 per cent. In suspected cases there is a considerable variation in the per cent. of positive results in the tables of different workers, due in part no doubt to the personal equation involved in the estimation of symptoms necessary to constitute "probable" or "possible" tuberculosis. In general, experience teaches that Koch's tuberculin reaction has a high grade of diagnostic value.

Koch-Weeks bacillus. This organism, the bacterial cause of epidemic, contagious conjunctivitis, is a small, very slender microorganism with rounded ends. It stains best with dilute Loeffler's methylene blue or carbol-fuchsin, and is negative to Gram's stain. See **Bacteriology of the eye**; and **Bacillus, Koch-Weeks.**—(S. H. M.)

Koch-Weeks conjunctivitis. See **Conjunctivitis, Acute contagious.**

Koeller, Ferdinand. The first physician in Pittsburgh to make a specialty of diseases of the eye. Born at Feldbach, Austria, Nov. 24, 1834, he received his medical degree at the University of Gratz in 1857. He practised then in lower Austria until 1859, when he began to serve in a general medical capacity in the war with Italy. After the war he was for a time Assistant Professor at the University of Gratz. In 1865 he migrated to America, settling in Pittsburgh as an ophthalmologist. He soon had a large practice and a wide reputation. He was a man of great personal charm and kindness of heart. He mar-

ried in 1880 Otillia Wetzel, who died in 1891. The doctor himself passed away at his home on Walnut Street, Mt. Oliver, early in 1915. —(T. H. S.)

Kohle. (G.) Charcoal; coal.

Kohlenoxyd. (G.) Carbon monoxid.

Kohlenoxydvergiftung. (G.) Carbonic oxid poisoning.

Kohlensäure. (G.) Carbonic acid.

Kolben. (G.) Bulb.

Koller's loupe. See p. 3386, Vol. V, of this *Encyclopedia*.

Kölliker's layer. The mesiris; the *substantia propria* of the iris.

Kölliker's nucleus. The gray matter surrounding the central canal of the spinal cord.

Komoto's operation. A cosmetic procedure devised and employed by the Japanese ophthalmologist, Komoto, for the advancement of such blind phthisical eyes as present only slight changes in the iris and cornea. First, the palpebral fissure is widened by the excision of a strip of skin from the upper lid. Then the external rectus and the optic nerve are cut. Finally, a piece of fat is implanted behind the ball. The results are excellent.—(T. H. S.)

Königshöfer, Oskar. A well-known German ophthalmologist, founder of the "Charlotten Heilanstalt für Augenkranke," at Stuttgart, and for many years editor of *Die Ophthalmologische Klinik*. He was born in 1852, was Director of the Charlotten Heilanstalt for twenty-eight years, was for a long time Professor of Veterinary Ophthalmology at Stuttgart. He died April 11, 1911, aged 59. —(T. H. S.)

Koniscope. This is an optical instrument for indicating the quantity of dust in the atmosphere. The air to be tested is drawn into a tube, where it is moistened and cooled by expansion, thus condensing moisture on the dust-particles and rendering them visible as a fog or haze. The depth of color indicates the degree of impurity.

Konjugierte Brennpunkte. (G.) Conjugate foci.

Kontralnesin. A preparation of colloidal mercury with arsenic, phosphorus, and salicyl-sozoidol-quinin sublimate: used for syphilis.

Kopf. (G.) Head.

Kopfschmerz. (G.) Headache.

Kopiopia. Copiopia. Asthenopia.

Kopræmia. Blood-poisoning from the retention of fecal matters in the blood.

Korectome. Same as corectome (q. v.).

Korectopia. Corectopia. Displacement of the pupil. See p. 3323, Vol. V, of this *Encyclopedia*.

Körnerkrankheit. (G.) Granular ophthalmia.
Körnige Bindehaut. (G.) Granular conjunctiva.
Koromegin. (G.) Old name for atropin.
Koroscopy. A name for skiascopy.
Körper. (G.) Body; corpuscle.
Körperbeschaffenheit. (G.) The bodily constitution.
Körperchen. (G.) Corpuscle.
Körpergrösse. (G.) Bodily size; stature.
Körperhaltung. (G.) The attitude or carriage of the body.
Körperkreis. (G.) Systemic circulation.
Körperschwäche. (G.) General debility.
Körperstärke. (G.) Physical strength.
Körperübung. (G.) Physical exercise; athletics.

Kortum, Carl Georg Theodor. An 18th century physician, of but slight ophthalmologic importance. Born at Dortmund, the son of an apothecary, May 29, 1765, he received his medical degree at Göttingen, practised for about five years in Dortmund, and then removed to Stolberg, near Aix-la-Chapelle. Here he was made district physician, in which capacity he labored for many years. In 1835 he celebrated the fiftieth anniversary of his practice. He died Feb. 9, 1847.

He wrote a considerable number of books and articles on topics connected with general surgery and medicine, but only one on ophthalmology. This he called "*Medicinish-Chirurgisches Handbuch der Augenkrankheiten*" (2 vols., Lemgo, 1791-94). The writer has never seen a copy of the work, but Hirschberg calls it "incomplete, in spite of all its length, and devoid of original observations."—(T. H. S.)

Koyle, Frank Harcourt. A well known Canadian-American ophthalmologist. Born at Athens, Canada, in 1865, he received his medical degree at Queen's University, Kingston, Ontario. For a time he engaged in general practice at Lowell, Mass., but after a considerable period of study of the eye, ear, nose and throat in the New York hospitals, he settled, as ophthalmologist and oto-laryngologist at Brockville, Ont. In 1894, however, he removed to Hornell, N. Y.

As to the Doctor's personality, we quote the following from Dr. Harry V. Würdemann: "It is not alone as a physician that Dr. Koyle will be missed by friends without number. His genial presence, his social gifts, his rare voice, always at the service of his friends and of every organization which asked his aid—his sweet spirit toward all things and all men—have enabled him to add more to the joy of life than it is often given to one man to do."

Dr. Koyle married in 1894 Miss Maude McDowell of Penn Yan, N. Y. He died in August, 1911, at his home in Hornell.—(T. H. S.)

Koyter's muscle. The corrugator supercilii.

K. p. A contraction for *keratic precipitates,* such as are seen in various kinds of "descemetitis."

Kraemer, Adolf. A celebrated oculist of Switzerland and California, author of a volume of the Graefe-Saemisch *Handbuch der ges. Augen-*

Adolph Kraemer.

heilkunde (2d ed.) entitled "Animal Parasites of the Eye." Born at Giessen, Germany, June 20, 1864, he received the degree of Doctor of Philosophy at Basle, Switzerland, in 1892, his dissertation being "Parasites of Fresh Water Fishes." The degree of Doctor in Medicine he received at Zürich in 1894, on which occasion his dissertation was "Spinal Meningitis." For the next six months he studied gynecology with Pozzi, of Paris. Soon, however, he turned to ophthalmology, which he found more to his liking. For a time he was

assistant in ophthalmology at the University Clinic at Basle, and afterwards, for a somewhat longer period, at Zürich. Then he practised for a number of years at Heiden, a Swiss watering-place. While there, he contributed numerous ophthalmologic articles to various German, French and English journals. From Heiden he removed to San Diego, California, U. S. A., where he practised from 1902 until the end of his life. In 1898 he married Mary Clifford Webster, daughter of the late John Ordway Webster, of Augusta, Me. Of the union were born two children, Hilde and Eric, both of whom survived Dr. Kraemer, who died Jan. 22, 1911.

In every way the subject of this sketch was a man of striking personality. Six feet high, broad-shouldered, with black mustache and beard, black hair, brown eyes, and a very vivacious expression and manner, he produced at once a decided, as well as enduring impression. He was eager and rapid in conversation, extremely congenial, and yet not fond of society. His studious tastes would seem to have prevented that. His temperament was mercurial; he easily elated and easily depressed. In the wonders of nature, however, he found a perpetual solace. His chief recreation was botanizing. He collected a fine herbarium of Southern California, which he presented to the University of Basle. He was an ardent devotee of outdoor life, from its smallest to its largest forms, and was on the point of removing his family to the shores of Lake Constance, Switzerland, because of the beautiful scenery there, when the summons came to leave this world, which he had found so beautiful and so full of changing interests.—(T. H. S.)

Kraft. (G.) Force.

Krampf. (G.) Spasm; convulsion.

Krampfader. (G.) Varix.

Krampf des Auges. (G.) Spasm of accommodation.

Krampfhaft. (G.) Painful; convulsive; spasmodic.

Kranichfeld, Friedrich Wilhelm Georg. A well known German physician, of slight ophthalmologic importance. Born at Hohenfeld, Thuringia, Aug. 30, 1789, he began to practise in Vienna about 1816, and, from 1818 till '21 was physician to the Austrian embassy at Constantinople. In 1822 he became extraordinary professor in Berlin, and four years later established an "Ophthalmo-Policlinical Private Institute" in the University building. In 1831 he became ophthalmic physician to the city poor.

He was a very eccentric man, full of crotchets and whimsical ideas. He attempted for a time to establish a new sort of religion which he

himself had thought out. In 1868 he resigned his professorship, disappeared and nothing further is known concerning his life.

Aside from numerous writings of a general medical character, he wrote: 1. Anthropologische Übersicht der Gesammten Ophthalmiatrie (1841). 2. Conspectus Publicus Morborum Ophthalmicorum qui . . . Instituto Policlinico Ophthalm.-Privato suo . . . ab a. 1830 Usque ad a. 1842 Tractati et Sanati, etc. (1842).—(T. H. S.)

Krank. (G.) Sick; disordered.

Kranke. (G.) A patient.

Krankengeschichte. (G.) A clinical history.

Krankenpflege. (G.) The care of the sick.

Krankheit. (G.) Disease.

Krankheit der heiligen Regina. (G.) Old name for syphilis.

Krankheitsbild. (G.) A clinical picture.

Krankheitserreger. (G.) An exciting cause of disease.

Krankheitserscheinung. (G.) A symptom.

Kranz. (G.) Corona; crown.

Kraspedoscopy. A name suggested by Schoen for skiascopy, or the shadow test, from *kraspedon*, a margin, because, in this method, the illumination of the retina takes place across the margin of the pupil, as a heavenly body, e. g., the moon, is seen to rise over the crest of a hill.

Krause,* Karl Friedrich Theodor. A celebrated German anatomist, internist, medical official and ophthalmologist, whose name has been perpetuated in the acinous glands of the conjunctiva (discovered by him) and who also discovered the layer of ganglion cells of the retina, of the nerve cells of the *orbiculus ciliaris*, and of the distinction between the supraorbital and frontal foramina on the *margo supraorbitalis*. Born Dec. 15, 1797, at Hanover, he studied at first at Hanover and was for a time a military surgeon. Released from active service, he entered Göttingen University, where he received the degree of M. D. in 1818. In 1820 he settled in Hanover as general practitioner. Here he soon became Professor of Anatomy, and, in 1852, Director of the Upper Medical College. He was a remarkably able lecturer and writer. He died at Hanover June 8, 1868.

Krause's chief ophthalmologic writing is "Einige Bemerkungen über die Gestalt und die Dimensionen des Menschlichen Auges" (Meckel's *Archiv*, 1832; Poggendorf's *Annalen der Physik*, Vol. XXXVI, XXXIX, 1833, 1836).—(T. H. S.)

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*Not to be confounded with his son, Wilhelm Krause, of Göttingen, who has also rendered lasting services to ophthalmology.

Krause's corpuscles. These are special nerve endings in the conjunctiva found beneath the epithelium and discovered by Krause.

Krause's glands. See **Glands, Krause's.**

Krause's operation. Extradural excision of the Gasserian ganglion for trigeminal neuralgia.

Krause, Valve of. See **Valves of the lacrimal canals.**

Krebs. (G.) A general term for cancer and other malignant tumors, infiltrations, and ulcers; also a crab.

Krebsschwamm. (G.) Medullary sarcoma.

Kreide. (G.) Chalk.

Kreisbogen. (G.) A quadrant.

Kreislauf. (G.) Circulation.

Kreso. A coal-tar product containing cresols and phenols: used as a disinfectant and sterilizer for instruments, etc.

Kresofuchsin. A blue-gray powder used as a stain in histology. Its aqueous solution is red, the alcoholic solution blue.

Kreuzung. (G.) Crossing; decussation.

Krezungsstelle. (G.) Point of decussation.

Kromskop. An apparatus used for the color photography of pathologic specimens.

Krönlein, Rudolph Ulrich. A celebrated Swiss general surgeon, inventor of osteo-plastic resection of the orbit. Born in Canton Schaffhausen, Feb. 19, 1847, he studied at Zürich, Bonn, and Berlin, returning at length to receive the degree of M. D. at Zürich. In 1878-79 he filled the chair of surgery at Giessen, from 1879 till '81 the extraordinary chair at Berlin, and in 1881 returned to Zürich to accept the full professorship in that institution, as well as the directorship of the Surgical Hospital. Both these positions he resigned in 1910, shortly before his death, which also occurred in that year.—(T. H. S.)

Krönlein's operation. The exposure of the contents of the orbit by resection of its external wall was first suggested by Wagner (*Sammlung Klin. Vorträge*, No. 271, p. 86, 1886) for the purpose of removing deeply-lodged foreign bodies. According to Wood's *System of Ophthalmic Operations*, Vol. I, p. 851, this procedure, much improved, was made applicable by Krönlein (*Beiträge z. Klin. Chirurg.*, IV, I, 1887) to the removal of certain orbital tumors without sacrifice of the eyeball. His method is as follows: A crescentic incision is made through the skin at the external margin, cutting through and stripping the periosteum from the external wall of the orbit and then sawing or chiseling from this wall a wedge-shaped piece of bone whose apex corresponds to the sphenomaxillary or inferior orbital fissure. The loosened osseous segment may now be turned out towards the temple,

exposing for operative purposes the whole length of the orbital cavity with its contents. After the necessary surgical intervention, the bony wedge is replaced and the edges of the wound in the soft parts brought together by sutures.

For this operation a number of instruments are required besides the ordinary ones for dividing the tissues, retractors, raspatoria, ten-

Krönlein Operation. Incision Through the Soft Parts.

acula, osteotome, mallet and chisels, dental engine with its usual saws, strong bone and tissue forceps, suture material, stout needles and needle-holder, and spatulæ.

After the field of operation has been carefully prepared, the hair about the face and temple shaved, etc., the patient is placed under the proper general anesthetic.

The first step is the incision of the soft parts made in the manner shown by the accompanying figure.

It describes an arc of a circle with the convexity towards the external angle, beginning about half an inch above the angular process of the frontal bone and terminating about the middle of the zygoma. The upper-middle part of the incision follows the outer margin of the orbit and involves only the skin, fascia and part of the muscle. In the middle and lower part the incision should reach the bone. The whole incision ought, in adults, to be about 8 cm. long. The periosteum in the deeper portions of the incision along the outer margin of the orbit should be thoroughly incised, raised and loosened by means of an elevator. Then, working over the margin into the orbit towards its apex, the periosteal lining is carefully separated until the spheno-maxillary fissure is reached and the bone freely exposed. An assistant meantime holds the orbital contents away from the operative field by means of a spatula. The soft parts should not be dissected from the external surface of the proposed wedge. It will be noted that the apex of the osseous cut (see figure) lies about the middle of the fissure.

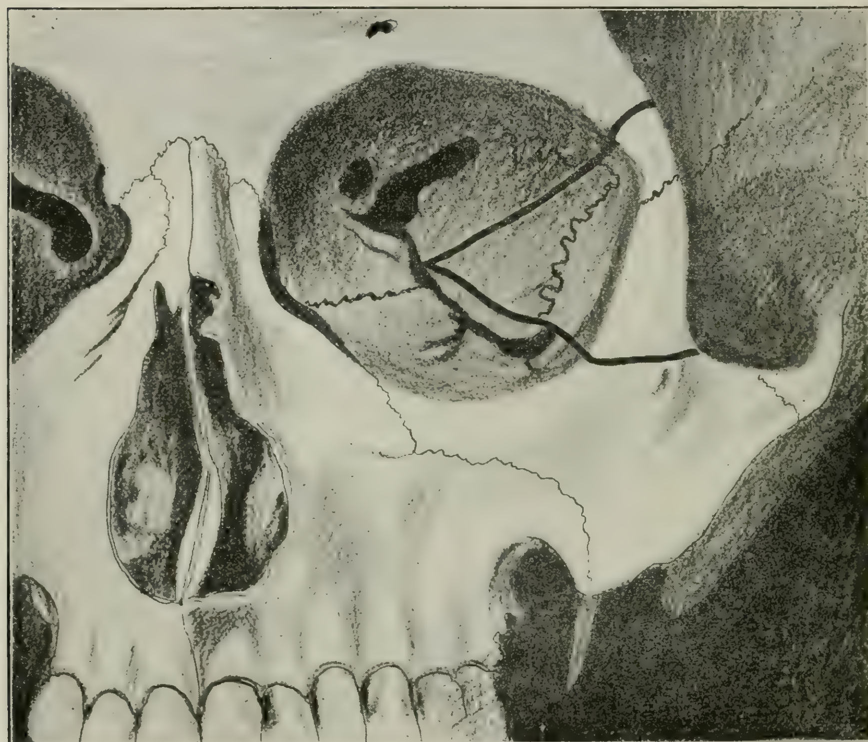
The cutting of the bone may be done by a small hammer and flat chisels but the dental engine, provided with both circular and band saws, is preferable as it is so much more easily worked. Moreover, the saw makes a neater cut and does not splinter the bone or necessitate chipping of the osseous structures.

Whatever instruments are employed it must be remembered that the initial bone incision runs through the base of the external angular process of the frontal while the second part of it extends downwards and backwards (mostly parallel to the orbito-malar suture) to the centre of the spheno-maxillary fissure. as shown in the figure. To join this and form the wedge pictured in the illustration, a second cut, beginning about 3 cm. below the first, is directed through the base of the orbital process of the malar bone to the anterior end of the fissure. A further extension of this cut, to meet the first and from the apex of the operative wound, is made with stout, blunt scissors.

In this way is dislodged a triangular piece of bone measuring about 3.5 cm. in length and 3 cm. in width, composed of practically the whole of the external orbital margin and that portion of the external wall whose outer surface forms part of the temporal fossa. By grasping it with forceps and moving it gently back and forth it may be further loosened from its attachments and with a resection hook turned outwards on the temple.

The lateral aspect of the orbital cavity to its apex and to a large extent above and below is now exposed to view. Growths, foreign bodies, etc., can be readily examined and removed with the least dam-

age to the important organs that surround them. For this purpose the periosteum should be cut through, on either the upper or lower border of the external rectus muscle, with a pair of blunt scissors and the globe drawn forward and towards the median line as much as possible. If the tumor lies outside of the muscle cone it can easily be enucleated, but if inside the muscles or well behind the eyeball one



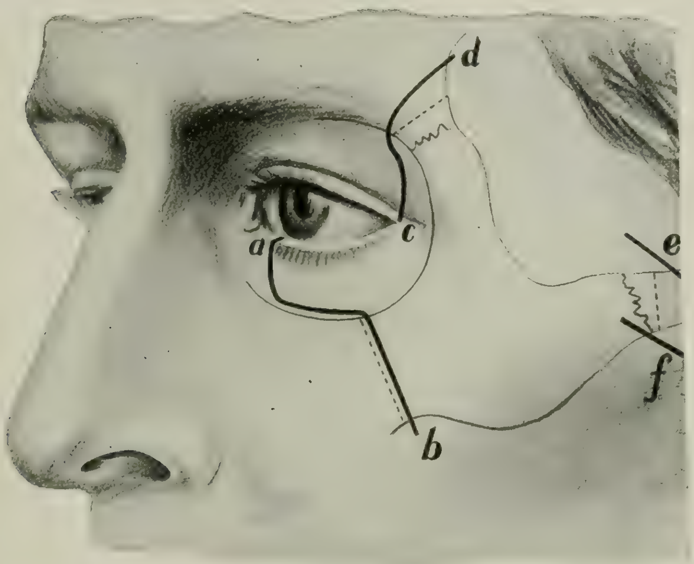
Krönlein Operation. Incisions Through the Bones.

or more of the straight muscles, generally the externus, must be drawn to one side by hooks held by an assistant. If this does not sufficiently expose the field of operation, the external rectus should be cut through behind the check ligaments, catgut sutures having been passed through each of the cut ends so that they may be reunited after the operation.

When the operation is concluded the cut muscle ends must be rejoined and the bony pyramid restored to its normal position. Drawing the latter gently forward at first will assist in "settling" it where it belongs. The soft parts should be carefully stitched, using catgut for the periosteal wound. An iodoform gauze drain should be laid in

the most dependent part of the skin wound. The lower conjunctival sac should be filled with a 10 per cent. orthoform salve and the lids held together with plaster. Axenfeld advises a provisional tarsorrhaphy instead of adhesive strips. Over all dry iodoform gauze and a light bandage.

If there be no rise of temperature, little local swelling and not much discharge—and there is generally none of these complications



Czermak's Osteoplastic Resection of the External Orbital Wall.

a, b, c, d, e, f, The incision through the soft parts. The dotted lines indicate the deviation of the bone sections from those of the usual Krönlein operation. (After Czermak.)

if the operation is properly performed with due aseptic precautions—the dressings need not be disturbed for three days. In the average case it is well to change the drain on the second day and to remove the superficial stitches—if these are not of absorbable gut—on the fifth or sixth day.

Czermak's osteoplastic resection of the external orbital wall. Czermak (*Deutsch. med. Wochenshr.*, No. 39, 40, 1905) has considerably modified the original Krönlein procedure so as to give more room for intraorbital operations. He would not discard the Krönlein procedure but reserves his own operation (1) for the removal of small tumors occupying the extreme apex of the orbital pyramid, (2) for tumors lying beneath the globe and reaching well forward and (3) for such

growths as lie on the nasal side of the eyeball, in which case the eyeball would have to be drawn well outwards to permit of its removal from the front. His incisions compared with those of Krönlein may be traced in the accompanying figure.

It will thus be seen that in this operation the body of the malar bone, as well as the orbital process is removed, i. e., most of the orbital floor. He uses for the purpose a small chain saw worked from behind forwards with a to-and-fro motion.

There are several other modifications of the Krönlein operation, some of them desirable, perhaps, in particular instances, but on the whole the original method holds its own as a useful and comparatively safe operation.

Parinaud (*Annales d'oculistique*, Vol. 126, 1901, p. 241) and Roche, to avoid the rather marked cicatrix left by the usual operation recommend a square flap of the soft parts, reaching from the temple to the margin of the orbit. The incision commences at the outer end of the eyebrow, runs horizontally backwards about 5 cm., then vertically downwards 5 cm., and finally 5 cm. horizontally forwards. The rectangle of skin thus enclosed is loosened up to its base and turned over forwards. The remainder of the operation is the usual Krönlein procedure. Some observers believe that the post-operative healing is more uncertain in this than in the case of the Krönlein method.

Angelucci (*Atti del' Congresso Italiano d' Oftamologia*, 1905) advises that the incision (4 cm. long) through the soft parts begin at the external angle of the orbit and run vertically to the base of the orbital process of the malar bone. From the lower end of this he makes another about 20 mm. along the upper border of the zygoma. With a saw he then divides the orbital process of the malar to a depth of 6 mm. below; above, he follows the frontal-malar suture in the same way for 3 mm. He then raises the periosteum from the entire internal surface of the orbit and grasping the bone included in the incisions just mentioned dislocates it outwards, producing a fracture along the sphenoidomalar suture. Care is exercised not to use too much force and to supplement the saw, when needed, with bone forceps.

It will suffice, perhaps, simply to mention certain other modifications of technique in the Krönlein method, all of which may be more thoroughly studied in the original monographs. Among these are the malar orbitomy of Rollet (*Annal. d'Oculist.*, Vol. 126, p. 370), the temporary resection of the superior orbital margin of Cahen and Franke (*Deutsche Zeitsch. f. Chirurgie*, Bd. 59, Heft 1 and 2) and the operation, also made along the eyebrow, of Pihl (*Centralbl. f. pkt. Augenheilk.*, June, 1905, p. 171), the two last named intended espe-

cially to reach tumors lying above and to the nasal side of the globe.

Value of and indications for the temporary resection of the external orbital wall. Almost any area or point within the orbit, however deep or covered by the orbital contents it may be, is accessible to operative measures after one or other of the resections just described. Necrotic bone in otherwise inaccessible regions can be scraped or chiseled without danger, not excepting the floor of the cranial cavity. One should, however, exercise especial care in avoiding the lachrymal fossa with its glands, and the attachments of the muscles to the bony walls. Injury to the former may produce a chronic fistula and to the latter may interfere with the normal excursions of the eyeball.

As before mentioned, the operative wounds in these operations generally heal kindly, quickly and without complications.

Czermak and Elschnig sum up the indications for resection of the external wall of the orbit as follows: 1. In operations requiring operations on the lateral wall or posterior part of the eyeball; for example, in L. Müller's exsection of the scleral wall in separation of the retina the removal of subretinal cysticercus in the macular region, etc. 2. For extirpation of extensive tumors of the optic nerve, with retention of the globe. 3. For removal of orbital tumors in general, of cysts (dermoids, cysticerci), of osteophytes that lie deep in the orbit whose removal with retention of the eyeball, the optic nerve and preservation of the normal movements of the globe is attended by considerable difficulty. This object is most successfully attained when the tumor is situated on the lateral side of the nerve. 4. For the drainage of a purulent deposit following an orbital periostitis. 5. As a preliminary to the operation for the ligature and removal of aneurisms and varices, e. g., pulsating exophthalmus. 6. In the removal of retrobulbar fat in the treatment of the exophthalmus in exophthalmic goitre. 7. In the removal of foreign bodies imbedded in the apex of the orbit. 8. In opening the optic sheath for the relief of certain forms of choked disk.

In attempting to do the classical *Krönlein's operation*, the formation of a neat wedge of bone, such as the illustrations show, Harold Gifford (*Oph. Record*, March, 1912) has always found difficult or impossible. The bone has broken off before the spheno-maxillary fissure was reached; so that, while the fragment has been replaced with good results, he has in his later operations simply removed as much of the bone as was required and thrown it away. He has also used a straight, horizontal incision instead of a semicircular flap.

The results have been excellent, both from a cosmetic as well as a therapeutic point of view, so that he feels justified in recommending

the following procedure for tumors in the outer half of the orbit: 1. Horizontal incision 2½ to 3 inches long, beginning ¼ inch from the outer commissure, care being taken not to open into the conjunctival sac. It is, of course, not always possible to avoid opening the conjunctival sac, where work has to be done on the external rectus muscle, but, if possible, it is best to avoid connecting the sac with its constant population of more or less pathogenic germs with the orbital wound. 2. Wide separation of the lips of the wound and shoving back the periosteum from the outer side of the bone. 3. Removal with strong bone forceps of the outer margin of the orbit and as much of the outer wall as desired. 4. Opening the periosteum of the orbit and proceeding as usual.

As thus performed, the operation leaves a less disfiguring scar, and the sinking in at the site of the removed bone is so slight as to be practically unnoticeable, and is more than compensated for by the simplicity of the operation.

W. C. Souter, in the *Ophthalmic Review,* Oct., 1913, points out that Magitot and Landrieu (*Annales d'Oculistique,* Vol. 148, Nov., 1912) have also recognized that many surgeons shirk this operation on account of the troublesome resection of bone, so, after a number of experiments, they adopted as most satisfactory the classical curved skin incision, going deep, but mention that Golovine's incision around the outer orbital edge with division of external palpebral ligament gives access to the orbit, and can be supplemented by a horizontal incision along the zygoma if it is found necessary to resect bone. The periosteal lining of the outer orbital wall is separated off from 1 cm. above the fronto-malar suture down to a lower-outer orbital angle, and deep to the pterygo-maxillary fissure. The superior horizontal osseous section divides at its base the process of the frontal bone. The superior oblique cut goes from the depth of the first one in a line back and down behind the suture of the malar and the sphenoid to the pterygo-maxillary fissure, while the inferior osseous section is horizontal, traversing at its base the frontal process of the malar bone. The cuneiform fragment of bone, plus soft parts, should turn outwards quite easily.

Angelucci's conversion of the resection to a permanent one is out of place where the globe is to be retained, while the tri-radiate or trefoil resection of Czermak and Gangolphe, in which most of the malar bone and the orbital extremity of the great wing of the sphenoid are removed, gives very little extra access—in fact only about 2—3 mm., and that too only at the orbital edge, while there is the risk of opening

the antrum of Highmore and, from damage to and consequent atrophy of the masseter, of a bad cosmetic result.

These operators separate the temporal aponeurosis along the orbital process of malar bone and for 1 cm. along the zygoma. Separation of the outer orbital wall periosteum is simple and the lacrimal gland need never be disturbed. The orbital contents are retracted inwards with Poirier's malleable retractor. Straight saws are unwieldy and are risky for the soft parts, and if a gouge is placed in the saw cuts only the orbital border chips off, and splinters thus removed with bone forceps are useless for replacing. Mallet and chisel do not yield a single large fragment and they may cause brain upset. Krönlein suggested a very convex cranial "cock's comb" saw and Lagrange a chain saw. Cranial circular saws never get down to the fissure. The authors found it necessary to begin at the fissure and saw outwards, using a Gigli fine thread saw. At the angle formed by the orbital process of malar and the zygomatic arch—lower down than one is inclined to suppose—one introduces, while the soft parts are retracted, a malleable grooved probe, or a silver canalized sound or a malleable conductor like Delbet's used for the dura but rather straighter, moulded to suit. It is passed in at the angle and one feels for the fissure about 1 inch deep to the orbital border of the malar bone. The end appears in the depths, the saw is passed along and grasped in the orbit by forceps and pulled out. The section is then made quite low, and the surgeon then readily recognizes the fronto-malar suture and with an adjustable saw he cuts to a depth of 5 mm. here, then with a small chisel held vertically in this groove and a few taps by the mallet the bone is split to the fissure and the whole fragment, from whose outer surface the periosteum has not been removed, can be turned back like a gate on its hinges. The orbital periosteum is now opened and the condition dealt with, with or without division of the external rectus. The flap is then replaced, and all stitched up.

The idea of using a Gigli saw in this operation is not original with the present authors, but they have certainly defined its use in a very satisfactory manner; and a good many eyes might be saved by this operation, which at present have to be sacrificed in the anterior operations, which are most usually adopted.

Kropf. (G.) Goitre.

Krötengift. (G.) Toad poison.

Krötenmelde. (G.) Datura stramonium.

Krukenberg, Peter. A famous German physician, of a slight ophthalmologic importance because of his graduation dissertation, entitled "De Cancro Bulbi Oculi Humani." Born at Königslutter Feb. 12,

1788, he received the medical degree in 1808 at Göttingen, practised and taught at Halle, and died of cancer of the palate Dec. 13, 1865.—(T. H. S.)

Krümmung. (G.) Curve.

Krümmungshalbmesser der Hornhaut. (G.) Radial curvature of the cornea.

Krümmungsmittelpunkt. (G.) Centre of curvature.

Krymotherapy. The therapeutic use of cold.

Kryptoglioma. Cryptoglioma. See p. 3573, Vol. V, of this *Encyclopedia*.

Kryptok lens. A *bifocal lens* having even surfaces on both sides and made of glass of different indices of refraction, such as crown-glass and flint-glass, the major lens of crown-glass having an eccentric spherical recess in it in which is secured by fusion, or otherwise, the minor lens of flint-glass. Fused blanks are commercially produced to enable opticians to finish both sides of the desired bifocal lens. See p. 4945, Vol. VII, of this *Encyclopedia*.

Kryptophthalmia. See **Cryptophthalmia.**

Kryptosarkoma. See **Cryptosarcoma.**

Kryptoscope. Another name for the fluoroscope. See p. 5232, Vol. VII of this *Encyclopedia*.

Krystallene Feuchtigkeit. (G.) The crystalline lens.

Krystallinsenkapsel. (G.) Capsule of the lens.

Kubisagari. See **Gerlier's disease.**

Küchler, Heinrich. A distinguished German ophthalmologist, the inventor of test-types. Born at Darmstadt, Germany, April 23, 1811, he studied at Giessen and Paris, and in 1835 founded an eye infirmary in his native city. In 1836 his rapidly increasing practice was completely broken up by an imprisonment of several years' duration, most unjustly inflicted upon him because of his participation in certain agitations made by the student-body of the University. For the greater portion of about three years he lay in a foul, damp cell, in consequence of which exposure he suffered throughout the remainder of his life from the tortures of severe sciatica.

On his release in 1839, he re-opened his Ophthalmic Institute, and began to rebuild his practice. In 1844 he founded "Das Mathilde Landkrankenhaus." In 1862 he became Medical Councillor, and a few years afterward Privy Upper Medical Councillor. He died Mar. 29, 1873, of a long-continued and painful disease of the bladder.

He had an enormous practice which he well deserved, being a man of excellent judgment and a skilful operator. According to Hirsch-

berg, he left a collection of 30,000 case histories from his private practice.

We have already stated that Küchler was the inventor of test-types. The question of priority in this matter, which has been extensively investigated* by Hirschberg, may be stated very briefly as follows: Alfred Smee, of London, had nothing at all to do with the invention in question, though by both Snellen and Londolt he is stated to have invented, or at least to have proposed, the use of rows of letters for testing purposes in 1854. Küchler, however, in 1843, described the letters which he had invented and actually employed them in his practice. Küchler's cards, it must be remembered, however, were employed only for the testing of near vision. The first to publish a complete collection of test-types was Ed. v. Jaeger, of Vienna, in 1854. The first to state upon the card, next to each row of letters, the distance at which that row could be discerned by the normal eye, was Stellwag von Carion, of Vienna, in 1855. Snellen, of Utrecht, finally, put the cap upon the sheaf, by the invention of letters which, from above downward and also from side to side were composed of five (in the same line equally) large blocks, or square units, each block, at the normal distance which was expressly stated for the line, subtending an angle of exactly one minute.

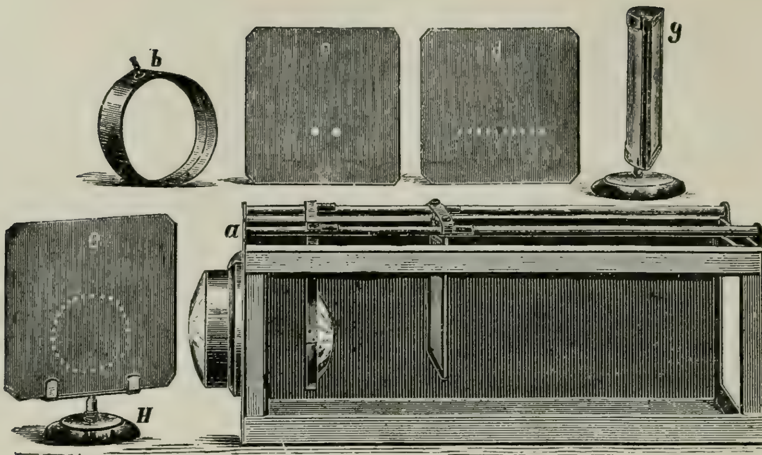
Küchler's ophthalmologic writings are as follows: 1. Schriftnummerprobe für Gesichtsleidende. (Darmstadt, 1843.) 2. Die Horngeschwülste des Augapfels. 3. Eine Neue Operative Heilmethode der Sämmtlichen Wahren Hornhautstaphylome, etc. (Braunschweig, 1853.) 4. Kurze Zergliederung der Schrift des Dr. G. Simon, etc. (Darmstadt, 1858.) 5. Die Querextraction des Grauen Staares der Erwachsenen. (1868.)—(T. H. S.)

Kugel. (G.) Ball; bullet.

Kügelchen. (G.) Globule.

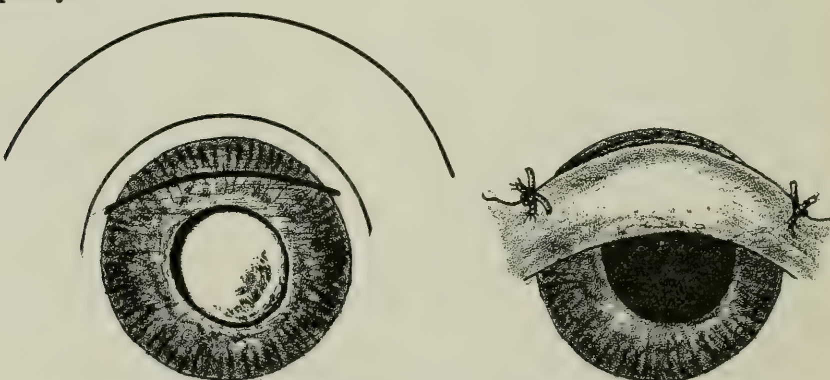
Kugel's test. This is a device whereby the use of cylindrical glasses is intended to unmask the pretense of unilateral blindness. See **Blindness, Simulated, Kugel's test for.**

Kühne's optical box. This well known method of demonstrating the effect of lenses and refractive errors in light rays entering the eye consists of a box with artificial cornea, iris, lens and other optical devices. The box is filled with water, while lenses of various strengths are so arranged that a graphic picture of an object, under the influence of various refractive conditions, is thrown upon the artificial retina. The passage, direction and relations of the incident rays and dioptric pencils can also be distinguished.

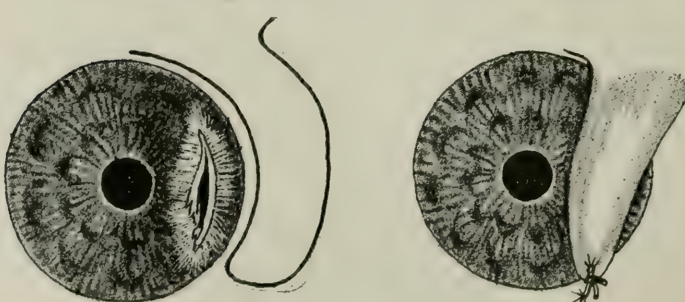


Kühne's Optical Box.

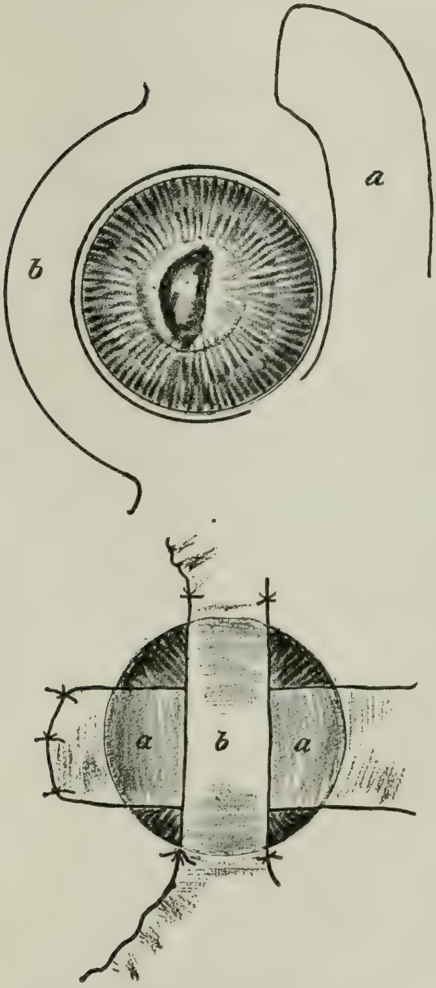
Kuhnt's flaps. Conjunctival flaps employed in the treatment of severe corneal ulcer; also used in cataract extraction. See **Conjunctivoplasty**.



Kuhnt's Bi-pedunculated Flap in Cataract Extraction.



Kuhnt Single Pedunculated Flap.



Kuhnt Double Conjunctival Flaps.

Kummerfeld's lotion. This collyrium is well known in Germany, where it is applied as compresses or used as eyewater at night in the home treatment of blepharitis. The formula is: Camphoræ, 0.40 (gr. vi); Lactis sulphuris, 4.0 (ʒi); Aquæ calcariæ (P. G.); Aquæ rosæ, āā 40.0 (f ℥ 1¼); Gum. acaciæ, 0.8 (gr. xii).

Künstliche Augenlidbildung. (G.) Blepharoplasty.

Künstliche Beleuchtung. (G.) Artificial illumination.

Künstliches Auge. (G.) Artificial eye.

Kunt, August Adolph Eduard, (1839-94). This scientist was born at

Schwerin in Mecklenburg; studied at Leipzig and Berlin (1867); was professor of physics at Berlin University, and there followed von Helmholtz. He made many experiments in magneto-optics, as well as original researches on light and on the velocity of sound in different gases. He died at Israeldorf, near Lübeck.

Kupfer. (G.) Copper.

Kupfertheilchen. (G.) Fragments of copper.

Kur. (G.) Cure.

Kuranzeige. (G.) A therapeutic indication.

Kurhaus. A house designed for the convenience of patients at mineral springs.

Kurokusakame. Fu. Fumuski. See p. 3101, Vol. IV, of this *Encyclopedia.*

Kurtzwig, David George. A well-known Russian physician and medical official, of a slight ophthalmologic importance because of his graduation dissertation, "Diss. de Morbis Palpebrarum." Born at Riga, Russia, Oct. 4, 1764, he received his medical degree in 1788 at Jena, settled in Riga, became Medical Inspector for the Government of Livland, and died June 27, 1834.—(T. H. S.)

Kurz. (G.) Short.

Kurzsichtigkeit. (G.) Myopia.

Kussmaul, Adolf. A distinguished German physician, who introduced the stomach pump for the treatment of diseases of the stomach, and who, as ophthalmologist, was the first to show that the retina of man and other mammals is, in the fresh condition, absolutely transparent. Born at Graben, near Carlsruhe, Feb. 22, 1822, he studied at Heidelberg from 1840 till '45, but, as it seems, did not receive his medical degree there. While yet a student, however, he published an original composition, entitled "Die Farben-Erscheinungen im Grunde des Menschlichen Auges" (Heidelberg, 1805), a work which, in spite of the immaturity of its author, was crowned by the Heidelberg faculty, and, even at the present day, evokes the admiration of so critical an authority as Hirschberg.

From 1850 till 1853 Kussmaul practised as general physician in Kandern, then proceeded to Würzburg for graduate instruction, and there, in 1854, received his medical degree—whether *ad eundem* is not positively known. The following year he qualified as privatdocent in Heidelberg, and in 1857 was made extraordinary professor in the same institution. In 1859 he removed to Erlangen in order to accept the full professorship of internal medicine in the Erlangen University. In 1863 he held the corresponding chair in Freiburg i. Br., and in

1876 that at Strassburg. The date of his death is not ascertainable by the present writer.—(T. H. S.)

Kuttarosome. A structure at the neck of a retinal cone composed of a series of parallel bars.

Kyanol. (F.) Anilin.

Kyanophane. A supposed bluish pigment from the oil-globules of the retinal cones.

Kyanopsia. See **Blue vision**; also **Colored vision.**

Kyklitis. A form of the word *cyclitis.*

Kymograph. KYMOGRAPHION. KYMOSCOPE. An instrument for registering the height of the blood-pressure, as well as pulsatile and other vascular oscillations. Fick's hollow, C-shaped, metallic spring instrument is filled with alcohol. One end of the spring is closed; the other end, covered by a membrane, is brought into connection with a blood-vessel by a junction-piece filled with a solution of sodium carbonate. When communication is made with an artery the pressure rises, and the spring in straightening itself moves the closed end, and, by means of a vertical rod attached to the latter, a series of levers, one of which writes its movements upon a moving surface.

Kystitome. See **Cystotome.**

Kystoma. A spelling of **Cystoma.**

L

Laaser, Guillaume-Constantine. A French quack of the 18th century, who practiced chiefly at Marseilles, Avignon, Aix, and Montpellier. He sold a "Teinture Anisoles," "which cures all sorts of diseases in the eye except the blind [*sic*]; it is worth 6 francs an ounce."—(T. H. S.)

Labarraque's solution. See **Solution of chlorinated soda, U. S. P.**

Labes. (L.) Macula.

Laboratory methods. See **Laboratory technique.**

Laboratory technique and museum preparations of the eye. MICROSCOPY OF THE EYE. MACROSCOPIC PREPARATIONS OF OCULAR TISSUES. To some extent the technique of the usual forms of laboratory work in the preservation and examination of the normal ocular tissues and of the pathological products connected with them has been discussed under various headings; under **Bacteriology of the eye,** for instance, and under such additional minor captions as **Kaiserling's method; Decalcification of eye specimens,** etc. Still, some of the subjects of this major heading demand more extended attention. These will be considered under three main heads: (a) *Macroscopic preparations,* i. e. preserved specimens of the eyeball, or of gross sections of it; of tumors, etc. These larger preparations are mostly used for teaching and exhibition purposes and as museum specimens; (b) *The microscopic examination of the eye tissues,* and especially of methods employed in collecting, hardening, cutting and staining them; (c) *The examination of bacteria,* in particular the collection and staining of smears, the cultural methods commonly in vogue and other laboratory processes connected with the *bacteriology of the eye* (q. v.).

In addition to this major section the reader is referred to **Histology of the eye,** as well as to the text books and other writings of Parsons, Treacher Collins, Greeff, Pollock, and Ball, to all of whom the Editor is largely indebted for the material of this section.

MACROSCOPIC (MUSEUM) PREPARATIONS OF THE EYE.

The Editor (Casey Wood, *Jour. Am. Md. Assoc'n.,* Sept. 26, 1903) as chairman of a committee appointed for the purpose, reported a

number of processes for the preservation and exhibition of entire and partial eye-ball sections. In that report, which is here freely quoted, it was pointed out that the early methods of preserving the enucleated eyeball and other ocular tissues were very crude. The specimen was generally placed in a bottle of ethylic or methyl alcohol of unknown strength, which not only bleached and hardened the tissues, but rendered them useless for future microscopic sections. Shrinking of the globar walls and intraocular structures proceeded until the parts became quite unfit for use, either as museum preparations or for other teaching purposes. Attempts were now and then made, by the addition of glycerin and other agents to the alcohol, to retard these changes, but with little permanent success. Bichlorid solutions, Müller's fluid and other chromate preparations were found to be improvements on the alcohol mixtures, but even these were not satisfactory, requiring constant care and frequent changing of the fluid, else the tissues were not affected by stains subsequently used for microscopic sections. In any case the cornea became opaque, the iris discolored, the other parts stained, and only the coarsest changes in the bisected globe, such as tumors, dislocated lenses, detached retinæ, etc., could be distinguished. Indeed, it was not until Priestley Smith devised his well-known plan of preparing and mounting the divided eyeball in a glass receptacle containing gelatin that a decided advance was made in the preservation and exhibition of gross specimens.

To obtain fresh normal eyeballs for histologic study is extremely difficult, as comparatively few pathologic conditions require an enucleation of a healthy globe. The chief sources of such eyes are executed criminals, retrobulbar and epibulbar tumors, and resections of the upper jaw. An eye enucleated more than two—at the most four—hours after death is scarcely to be utilized for careful histologic research.

Pathologic material is more readily procured fresh, as the treatment often necessitates the removal of the globe or the diseased tissue. Some morbid conditions still remain which do not require an enucleation or excision of the diseased tissue and can consequently be obtained only after death.

After enucleation the assistant should exercise great caution not to allow the corneal epithelium to dry, nor to brush it off by reckless sponging with dry gauze.

Orientation.—The vessel into which an enucleated eyeball is placed should be labeled immediately after enucleation. Threads may be passed through the tendinous stumps of the internal and external recti muscles. But the form and asymmetry of the globe, the shape of

the cornea, the stumps of the tendinous insertions of the ocular muscles, the entrance of the two long posterior ciliary vessels, which perforate the sclera on each side of the optic nerve in the horizontal meridian, and the eccentric entrance of the optic nerve will prove of value in orientation.

Fixing.

The object of fixation is to retain the tissue-elements in the condition which the tissue presented in life or at the moment of death, and to prevent further postmortem changes. Most of the fixing fluids coagulate the albumin, while others dehydrate it.

Müller's fluid.

Potassium bichromate	2.5
Sodium sulphate	1.0
Distilled water	100.0

The fluid must be used in considerable quantities and renewed daily until it no longer becomes cloudy. For thorough fixation a period of six weeks at the temperature of the room (70° F.) will be required. By placing the specimen in an incubator at a temperature of 36° to 40° C. and changing the fluid daily fourteen days will suffice. To prevent the development of fungi a little camphor or carbolic acid may be added. Virchow recommends keeping the specimen in the dark to prevent the formation of precipitates in the tissues.

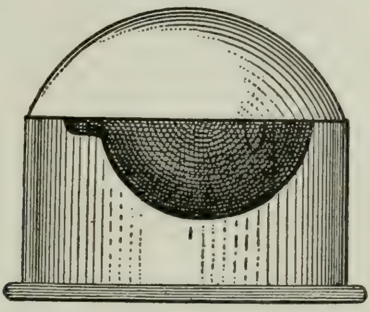
Preparations of thick sections of the eyeball may be preserved, although not as effectively as in specimen jars, by placing them on discs of opal glass over which a little prepared and melted jelly has been poured. The specimen is now covered with more jelly, air bubbles are removed by pricking them, and when the mass is hard enough a plano-convex lens is attached to the surface of the specimen just as one would apply a cover glass.

Dry methods of preparation. An ingenious plan was that of Hyrtl. He pierced the optic nerve of the enucleated eyeball and through the opening expressed the intraocular contents. The hollow globe was then inflated and dried. Beyond demonstrating the size and shape of the eye this method is useless, and has long been abandoned.

A more profitable proceeding is to harden the divided globe in alcohol, dehydrate by any suitable method and soak for ten days in turpentine. At the end of this time the tissues will be quite transparent. Now allow the turpentine to evaporate slowly. Such a specimen, if merely protected from dust, will keep indefinitely and will, especially when examined with a lens, show the tissues almost as well

as in any of the preparations about to be described. However, these preparations degenerate in time, owing to injury from handling and from exposure to dust and smoke.

The Priestley Smith gelatin method. The eyeball, generally preserved in Müller's fluid, is frozen (see the *Ophthalmic Review*, March, 1883), divided by means of a sharp razor and, when required, immersed in a 2 per cent. chloral-hydrate solution to remove at least a part of Müller's stain. This procedure is repeated every day or two until no staining of the immersion fluid results. To prevent shrinkage of the half eye when it is placed in the jelly, it is next given, for 24 hours each, a bath of 10, 25 and 50 per cent. glycerin. It is now (concave surface up) transferred to the glass jar, which should be



Treacher Collins' Modification of the Priestley Smith Jar.

about half filled with the melted gelatin. When the fluid jelly has entirely filled the hemisphere it is turned over so that its plane surface is accurately applied to the bottom of the specimen jar. Great care must be observed to prevent the retention of air bubbles within the globe or in the gelatin surrounding it. When the jelly is hard the jar is carefully filled with more gelatin.

The jelly consists of Coignet et Cie's gelatin, 1 part, glycerin and water, of each, 8 parts by weight. Slowly dissolve the gelatin in the water by the aid of gentle heat; add the white of one egg; boil thoroughly and filter through flannel. Finally, stir in the glycerin, to which has been added 0.1 per cent. of carbolic acid. The jar covers may be of ordinary clear glass, or of the white opalescent variety, cemented by means of four parts of gutta percha and one part of pitch. Treacher Collins suggested that a plano-convex lens be cemented on the upper surface of the jars by means of Canada balsam.

George Sloan Dixon's monograph (*New York Eye and Ear Infirmary Reports*, January, 1898) furnishes a complete description of

his formalin-jelly method of preparing the Priestley Smith mounts. It will also be seen that, in many respects, it is a decided improvement over the original mode of preparation.

The preparation of macroscopic eye specimens was very unsatisfactory until the advent of formalin as a hardening reagent. Time is also greatly economized by the use of formalin, as it requires but twenty-four hours to effect the preliminary hardening.

Formalin will not harden the vitreous, although it has the property of rendering this substance less viscid. For example, if an eye be removed from the formalin bath at the end of the first twenty-four hours and divided, the normal vitreous will be of a consistence similar to thin syrup, and is sure to be lost during subsequent manipulation.

In the majority of instances the loss of vitreous is of no great importance, but a more nearly normal macroscopic specimen will of course be obtained if it be preserved, and in some cases it is quite necessary. Therefore, in specimens where it is desirable to retain the vitreous, alcohol must be employed.

Another advantage obtained by the use of formalin, especially in intraocular tumor specimens, is that the finished mount shows the original colors to have been almost wholly retained, very little bleaching occurring.

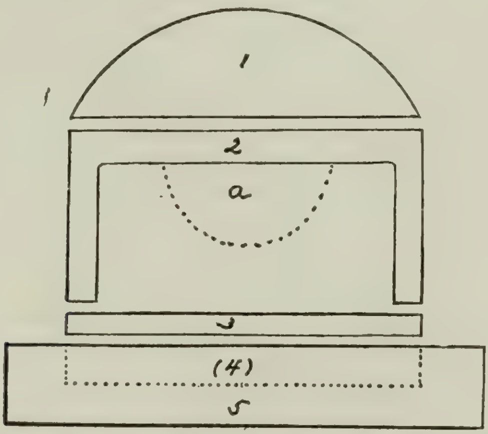
As soon as possible after enucleation puncture the globe at or near the equator with a small knife, in order to admit the fluid, and place it in a wide-mouth bottle containing a little absorbent cotton, and enough of a 10 per cent. solution of formalin in distilled water to cover it. Allow the eye to remain in this solution for twenty-four hours, and then transfer it to weak alcohol, 25 per cent. to 50 per cent., depending on the density of the globe, and increase the strength of the alcohol by about 10 per cent. daily. An inclination to collapse is an indication that the alcohol is being increased too rapidly. When the strength of the alcohol has reached 80 per cent., allow the specimen to remain in it for four days, or indefinitely if intended for future use. At the end of this time the vitreous will become sufficiently dense to permit division of the globe without loss.

The next step in the process is to remove the alcohol in order to permit the globe to be frozen. This is done by placing it in from ten to twenty times its volume of water for twenty-four hours. It is well to change the water at least once, though this is seldom necessary. When the globe has settled to the bottom of the vessel, sufficient alcohol will usually have been removed to allow freezing.

The freezing box should not be less than seven inches square—nine

inches is a very good size. It should have a few holes in the bottom for the purpose of drainage.

Remove the globe from the water, dry it carefully with a soft towel or piece of gauze, cut off the nerve close to the sclerotic and draw an ink line from cornea to nerve on both sides to indicate the direction desired to cut. In the majority of instances the horizontal plane is selected. Wrap the globe in oiled silk, without pressure on the globe. Fill the box with mixed pounded ice and salt, deposit the globe in the middle, cover and allow it to remain in a cool place for one hour. Remove the globe, rest it on a piece of cork and divide it quickly with a thin, sharp knife in the line previously drawn, being careful not to employ more sawing motion than is absolutely necessary, and further, do not rest the cornea on the cork.



Full-size Outline Figure of Macroscopic Cup and Accessories. (Dixon.)

1, Lens; 2, macroscopic cup; 3, porcelainized glass disc; 5, mahogany base showing (4) portion countersunk for reception of 2 and 3; (*a*) specimen.

Having divided the globe, place the hemispheres in distilled water to thaw. After ten or fifteen minutes remove the half selected for microscopic examination to 25 or 50 per cent. alcohol, and gradually increase the strength from day to day until 80 per cent. has been reached, where it may remain awaiting the further treatment required for imbedding. At the same time transfer the half selected for the macroscopic specimen to a 5 per cent. aqueous solution of chloral hydrate for twenty-four hours; glycerin and one-third water twenty-four hours; finally, equal parts of glycerin and water for twenty-four hours, when it will be ready to mount in glycerin jelly.

The formula for glycerin jelly has been repeatedly published, but as

ordinarily made it almost invariably has a marked amber tinge. This may be due to the quality of the gelatin used, but Dixon thinks it is frequently caused by the material through which it is filtered, flannel usually being recommended. The best quality of gelatin should be used, and nothing containing color should come in contact with the jelly during its preparation—even the shells of the eggs employed should be rejected if not pure white.

The following method of preparing the jelly is given in detail: Take gelatin, 1 part; water, 8 parts, and glycerin, 8 parts.

Dixon generally adds a trifle more gelatin, say 0.5 per cent. Cut the gelatin into small pieces, place in a glass vessel with a very wide mouth (fruit-jars are unreliable—agate-ware works well), add the water, cover and let it stand for an hour, then place the whole in an Arnold sterilizer, or in a water bath, and apply only sufficient heat to dissolve the gelatin. When dissolved stir in the albumin of one fresh egg (with its shell if white) for each ℥ viii. Replace in the sterilizer and boil until complete separation has occurred. Filter hot through absorbent cotton. A hot-water funnel is useful for this purpose. If the filtrate is not absolutely clear, repeat the operation. The glycerin is then added, and also enough carbolic acid to preserve it—not more than ʒ i of a 10 per cent. aqueous solution for each ℥ vi of jelly.

If carefully made in this manner the jelly will be almost free from color, and of about the same index of refraction as the glass of which the macroscopic cups are made.

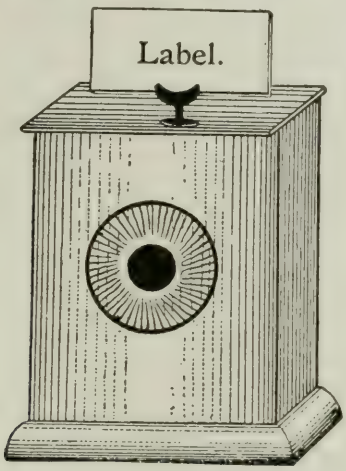
The jelly should be kept in two flasks, a large one for stock and a small one for use from day to day; both should be closed with cotton-wool plugs. The larger (or stock) flask should be heated only when necessary to fill the smaller one. Exclude light as much as possible. If evaporation occurs to any considerable extent before the jelly has been used, a little sterilized distilled water can be added.

The specimen is now ready to embed in its macroscopic cup. The cups (see cut) in use are $1\frac{7}{8}$ inches in diameter by $\frac{15}{16}$ inch deep, made of crown glass, upper surface highly polished and edge ground true.

Remove the surplus glycerin and water from the specimen and deposit it in the cup, cut surface up. Fill the cup with warm (not hot) jelly, tease out with warm needles all the air bubbles that have become imprisoned, turn the specimen over, press it firmly on the bottom of the cup, examine over a mirror, center and retain it in position by means of a small piece of cigar box ($\frac{5}{8}$ by 2 inches), through the center of which an ordinary pin has been driven. It is not necessary that the pin should penetrate the specimen, but it should be long

enough to permit the greater part of the weight of the piece of wood to be transferred to the specimen at the point of the pin. If the mount is satisfactory place it under a bell-jar to exclude dust, and with a piece of absorbent cotton saturated with a dram of formalin.

The statement has been made several times that the exposure of nutrient jelly to the vapor of formalin renders it insoluble by heat. Formalin vapor, free under a bell-jar, will render the surface of glycerin jelly in macroscopic cups denser to a very slight depth, but not wholly insoluble. A cup of jelly so exposed for five days could still



Jar for Museum Specimens. (Greeff.)

be completely melted in an Arnold sterilizer, with the exception of a very small ring at the margin of the cup.

Although formalin vapor acting on glycerin jelly under a bell-jar does not render the entire mass insoluble, no particular advantage is gained by its use, as a greater degree of heat is required to cause it to "run" and displace the specimen. In fact, the Editor has frequently noted liquefaction of old mounts during the summer months when the thermometer stood at 98 or 99 F., although the usual melting-point of normal glycerin jelly is about 105 F.

It would seem hardly necessary to call attention to the fact that pathologic specimens should not be exposed to a greater degree of heat than is absolutely necessary; but this should particularly be borne in mind with reference to the eye, as immediately the limit of heat is reached (and the degree is comparatively low), the globe, or hemisphere, will suddenly collapse and be damaged beyond hope of repair. Therefore, if there is any likelihood of necessity arising for

redissolving the glycerin jelly surrounding a specimen, it is a mistake to use formalin for "setting" the jelly.

After standing for two or three days, the cup should be sealed to prevent further evaporation. Many have found the most satisfactory material for this purpose to be porcelainized glass. It is pure white, and greatly improves the appearance of the specimen. It is attached to the bottom of the cup with Stratena or Major's cement, applied hot. A celluloid disc answers the same purpose, but it is not pure white, and it is difficult to find a satisfactory cement for it.

The mount has now been completed and can be filed away, but some prefer still further to protect it by cementing it into a square wooden base. These blocks are made of mahogany, and are countersunk in the middle about a quarter of an inch.

It is occasionally an advantage to cement a lens to the upper surface of the cup to show a foreign body, or anything of especial interest located below the surface. For ordinary specimens, however, a permanent lens is a useless expense, and, in the majority of cases, a disadvantage. When applied, for which Canada balsam should be used, the lens should be warm, and, of course, the surface absolutely clean.

Specimens prepared in this manner, if properly sealed, should remain in perfect condition indefinitely; but it will occasionally happen that the cement may not have perfectly attached the disc to the cup, and slow evaporation will occur. This will sooner or later be manifested by fissure of the gelatin, necessitating remounting if the fissures can not be filled with fresh jelly without imprisoning air. A good result can be obtained by cutting away the jelly about the specimen with a sharp knife, leaving smooth surfaces and the specimen *in situ;* then refill the cup with warm jelly. In case air has found its way under the specimen, cut off the upper surface of the jelly and melt with very gentle heat (not over 112 F.) and remount as before.

The well-known fact that exposure to light tends to darken gelatin suggests the advisability of shielding the mounted specimens from strong light especially.

About the only modifications made in the foregoing methods since their first publication consists in the more thorough drying of the specimen with calcium chlorid under a bell-jar, and a change in the manner of cementing the bottom on.

For the latter purpose Bell's cement, sometimes Major's cement, and sometimes Stratena, are used. After the cement has thoroughly set give the joint two or three coats of zinc-white, allowing each to dry thoroughly, and then for a finish apply a ring of asphalt. The latter is, however, not necessary.

Care should be taken not to expose the specimen too long to formaldehyd, as a reaction is likely to occur rendering the jelly opalescent. This causes no special damage, but the jelly ceases to be sparkling.

The disadvantage of the method is that in very hot weather the jelly may become liquid in a few specimens, but this has been largely obviated by turning the specimens upside down.

The advantages are that the natural colors can be in the main preserved, all the parts are held in their normal positions by the density of the medium, they are readily photographed, and they can be transported with safety; besides a globe damaged during laboratory manipulation can be restored with a little patience and a hot needle.

Harold G. Goldberg prefers the formalin-glycerin-jelly method modified as follows: Gelatin (best French) oz. i. Cut in small strips and soak in water for twelve hours, pour off water and dissolve in solution (x), consisting of glycerin, fl. oz. viii; water, fl. oz. viii.

Egg albumin, fl. oz. vi; thoroughly break up in a graduate with a spoon and mix with fl. oz. iii of sol. marked x, which should be hot when mixed. Filter through flannel into remaining sol. marked x, and mix thoroughly; place on water bath and after coming to boiling point, allow solution to simmer, without stirring, for five minutes until the albumin is coagulated. Filter through hot water funnel, or anything that will serve the same purpose, and add 30 m. of pure formalin, a drop at a time, stirring after each drop to prevent lumps forming; then cool.

This jelly is almost colorless, transparent and very firm, and is not melted by summer heat; in fact, after the jelly is several months old it is very difficult to melt it, even by prolonged exposure to the heat of a water bath.

In cases where the tissues are thoroughly impregnated with about 10 per cent. formalin solution before mounting, the additional formalin causes the jelly to contract, as it grows older (possibly over a period of several months), squeezing the water contained in it from its substance. This collects on the surface; Goldberg, therefore, does not permanently seal the lid of the cell until this complete contraction has taken place, nor does he quite fill the cell with jelly, allowing sufficient space for the water to collect. After this contraction has taken place, it is impossible to melt the jelly with even the actual flame; it will burn, but not melt, and if it becomes necessary to remove the tissue the jelly must be dissolved away.

Tissues hardened in 5 or 10 per cent. formalin solution having remained in the solution several days, may be frozen, cut and mounted without any further preparation.

If tissues hardened by the other methods, after having passed through the alcohols, are placed in a 5 or 10 per cent. solution of formalin for twelve hours, their preservation in the jelly will be more complete and permanent.

When the tissues are impregnated with the formalin solution, a capsule 5 or 6 mm. in thickness is formed around the eye, due to the hardening action of the formalin on the jelly. If the vitreous chamber is not already filled it will be occupied by a mass of tough jelly which preserves the form of the globe.

In any event, all alcohol must be removed from the tissues before mounting in the jelly or air bubbles will form around the tissues and spoil the appearance of the mount. Goldberg has mounted a number of eyes that had remained in 10 per cent. formalin solution only twelve hours. These were frozen, cut and mounted in the jelly immediately, thus practically preserving the first changes noticed.

The mounts are obtainable from Wall & Ochs. The jars are sealed with common white photographic paste (which is easily removed) until contraction has completely taken place. Then the water, described as collecting for months, is removed and the jars permanently sealed with xylol-balsam.

Allen Greenwood does not claim originality for the method he prefers, and which he describes as follows:

In order to preserve the colors he hardens the enucleated eye by the Kaiserling method. The various steps are:

1. Fixation for 1 to 4 days in, formaldehyde, 200; water, 1,000; nitrate of potassium, 15; acetate of potassium, 30.

2. Drain and place in 80 per cent. alcohol for 1 to 6 hours, then in 95 per cent. alcohol for 1 to 2 hours to restore the color.

3. Preserve in, acetate of potassium, 200; glycerin, 400; water, 2,000.

Fixation should be performed in the dark and the specimen kept in a dark place.

To section the eye it is first frozen by packing in pounded ice and salt.

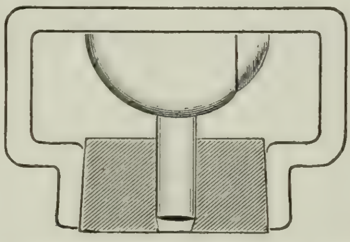
The half eye to be mounted is then placed in the glass dish with the cut surface down and the melted glycerin jelly poured in. If the glass dish is put on ice the layer of jelly next to the specimen will harden and the eye be held in place until the whole mass is hard enough to prevent the eye from floating. The dish should be filled full enough to exclude all air bubbles when the lid is applied. After the jelly becomes hard the lid is sealed on with Canada balsam.

The jelly is made as follows from the formula given by Verhoef:

Best French gelatin (Coignet's gold label), 30 grms.; cold saturated boric acid sol., 240 cc.

Add 80 cc. of glycerin and the white and shell of an egg, heat in a water bath, add 1 cc. of glacial acetic acid to precipitate the albumin. boil thoroughly for some minutes and then filter three or four times. Put the filtering apparatus in a steam sterilizer to prevent hardening of the jelly.

Edward A. Shumway uses the gelatin mount, as a rule, when it is desirable to make a macroscopic preparation. The gelatin is made in a rather stronger solution than is usually advised—40 grams of gelatin (Coignet et Cie) to 250 cc. of water. After solution of the gelatin by careful warming, the white of one egg, beaten up in a small quantity of water, is added to the solution, and the whole poured into an agateware pail. This is then placed in an Arnold sterilizer, and boiled



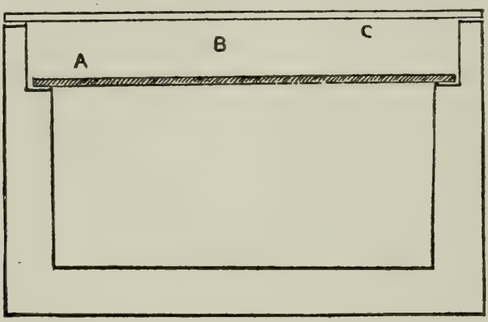
Cup, with Rounded Bases of Ebonized Wood, for Macroscopic Specimens. (Shumway.)

vigorously. In this manner the coagulation of the albumin and the clearing of the gelatin are accomplished without danger of burning the gelatin, a very important point, as the least scorching of the vessel around the top of the gelatin will give a brownish discoloration to the mounting medium. It is then filtered through a good quality of filter paper, preferably in a hot water filter, as the percentage of gelatin is very high, and the solution filters slowly. If it stiffens before filtration is complete, it may be put back into the sterilizer again, in the agate vessel, and reheated. To the filtrate an equal quantity of glycerin (C. P.) is added, and 1 cc. of a 2 per cent. solution of commercial formalin (making a solution of about 1/20,000, which is strong enough to prevent the growth of molds, etc.).

After the gelatin has hardened over the surface of the specimen in the cup it is exposed to the fumes of strong formalin in a covered glass jar, by means of which the surface is hardened to a depth of one-quarter inch. This prevents melting of the surface gelatin, and if, in addition, the cups are inverted, in warm weather, the specimens will

rarely be affected. After 24 hours the specimen is removed and allowed to stand under a covered dish several days, and the water which is squeezed out of the shrinking gelatin in the form of drops, over the surface, is removed by filter paper. The cup is then sealed. For this purpose opal glass is used, as it is much cheaper than the "flashed glass," and affords a better background than transparent glass. A most satisfactory cement is the Imperial rubber cement, which must be melted in a flame before it is applied, and renders the removal of the disc impossible, unless it is again heated. The danger of evaporation may be further prevented by covering the edge with a ring of asphalt.

Henry Albert (*Jour. Am. Med. Assocn.*, Oct. 9, 1915) remarks that the features desired in a *museum jar* are: Ability to display well the structures desired; good appearance and convenience of handling



Jar for the Permanent Preservation of Eye Specimens. (Albert.)

A, inner cover of opaque white glass; *B,* space between two covers to be filled with cement; *C,* outer cover of transparent glass beneath which label is attached.

specimen jar; permanency of the preparation; proper and permanent method of labeling the specimen.

Several of the museum jars for the preservation of eye specimens, now on the market, display the first two features. None of them, to the proper degree, exhibit the last two, especially when all of the desired features are considered.

With the idea of remedying such defects, Albert has so modified one of the commonly used jars as to insure both permanency of the specimen and proper labeling, in connection with the other desirable features which the jar already possesses (see illustration). This is accomplished by a double cover which is, as usual, placed behind the specimen. The inner of the two covers is made of white glass to furnish the proper background for the specimen. The outer cover is made of transparent glass beneath which the label is placed—thus insuring the permanency of the label. Between the two covers is a

space which is filled with the proper kind of sealing material. This entirely prevents evaporation of fluid from the jar and insures the permanency of the specimen. The jar is manufactured by F. A. Hardy & Co., Chicago.

W. N. Sharp (*Jour. Ind. State Med. Ass'n.*, March 15, 1914) deals with the details and technique of the mounting of ophthalmic specimens. If one-half of the eyeball is used for mounting, and the other half for miscroscopic purposes, it is freed from blood and extraneous matter and placed in a 10 per cent. formaldehyde solution for from twenty-four to forty-eight hours, after which it is washed in water, and placed in alcohol of 33 per cent., 40 per cent., 50 per cent., 60 per cent., 70 per cent., and 80 per cent. for twenty-four hours each, except the last, in which it may remain several days. The globe is then immersed in water to eliminate the alcohol, or until it sinks to the bottom, after which it is dried, wrapped in paraffin paper, or rubber tissue, and frozen, after the manner of ice cream. It can now be sectioned with a well-sharpened, thin-bladed case-knife, or a plano-concave razor. The section to be used for microscopic purposes is returned to the 80 per cent. alcohol, and the section for mounting is placed in glycerin one part and water three parts for twenty-four hours, after which it is transferred to a solution of glycerin one part and water two parts for twenty-four hours longer. The section is then placed in prepared gelatin which is made as follows: "Golden Label" gelatin 10 grams, water 62 cc.

Cut the gelatin into small pieces and heat in a small mortar over a Bunsen flame, constantly stirring the solution. After the gelatin is thoroughly dissolved, add a small portion of the white of an egg, and heat again, to clarify. Filter the solution through wetted filter paper, and to the filtrates add an equal volume of glycerin. Agitate the fluid with a glass rod and add 2.50 cc. of a 10 per cent. solution of carbolic acid. The cover of the specimen glass may be permanently cemented on with silicate of soda (liquid glass) after the glycerin jelly is hard and free from moisture.

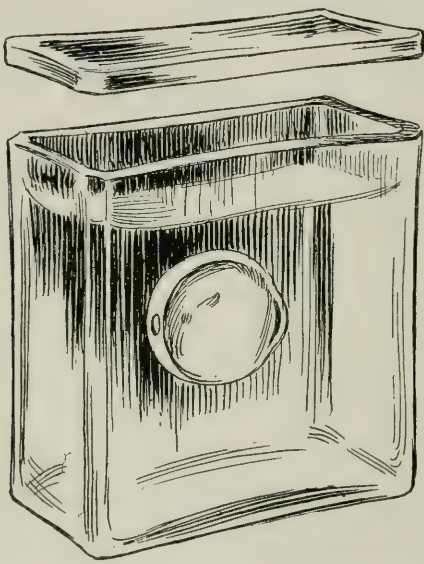
Permanent preparations in fluid preservatives.

Once surrounded by and impregnated with jelly, it is with great difficulty and small satisfaction that the bulbar hemisphere is utilized for microscopic purposes. This drawback can be obviated by its preservation in suitable fluids. The best known method is that of Greeff.

A number of modifications of the original method have been pro-

posed by various pathologists, both as regard the form of the glass receptacle and the preserving fluid.

Edgar S. Thomson advises that the specimen, after a thorough washing, be hardened for 24 hours in formalin, 4 per cent. The globe is then bisected, and the piece intended for mounting is wrapped in absorbent cotton, to prevent shrinkage, and immersed for three days in the following solution: Sodium acetate, 3; potassium chlorid, 5; formalin, 10; water, 100.



Glass Jar for Mounting Macroscopic Eye Preparations After the Greeff Method. (E. V. L. Brown.)

The specimen is then wrapped in a fresh piece of cotton and immersed in alcohol varying between 80 and 95 per cent., depending on the strength and resistance of the specimen to shrinkage. The alcohol should be as strong as possible. It is immersed in this for twenty-four hours, and finally is soaked for two or three days in the following solution: Acetate of potash, 90; glycerin, 180; water, 300. After which it is mounted in a fresh solution of the last formula.

The jars are from E. B. Meyrowitz of New York City. Thomson has not been in the habit of sealing the jars, finding that with glycerin preparation air bubbles are not apt to appear. The advantages of the method are as follows: It preserves the color and gives proper transparency to the cornea and lens, and the specimen can be removed from the jar at any time and a section made, although these are not

as satisfactory as fresh sections, on account of the shrinkage which the glycerin causes; it is nevertheless possible to make them, which can not always be said of the glycerin-jelly specimens. The method is simple, and three-year old specimens have kept very well.

E. V. L. Brown advises, in addition to the glass jar shown in the accompanying cut, the following method of liquid preparation:

1. A 3 per cent. formalin or Kaiserling solution.

2. Some gelatin glue. Dissolve three or four strips of ordinary cooking gelatin in an equal bulk of water and boil until the mass is thick and tenacious. It is then ready for use. On cooling, the solidified mass may be preserved for future use by adding a little alcohol; heat will promptly liquefy it.

3. Some shellac or japanner's gold size; "liquid glass" to seal the cover. The gelatin glue will answer this purpose very well unless the mount is to be sent through the mails.

The technic is not difficult. Carefully dry the half or one-third section of the eye, lay the jar on its side, put a drop of the gelatin glue inside, and place the specimen in position. Allow the glue to harden for fifteen minutes; place the jar upright, fill it with the solution and seal the cover. A small clasp may now be glued to the cover to carry a label or photograph.

The advantages of this method, especially over the Priestley Smith method so generally used in past years, are obvious, namely:

1. The Greeff method is quicker. It takes several days to prepare the gelatin, mount the eye and allow the jelly to harden according to the Priestley Smith method. The writer has mounted as many as twenty eyes by the Greeff method in a single morning.

2. The method is simpler and cheaper, and the mount more permanent. A good clear gelatin of the right consistency which will retain its solidity in hot weather is difficult to obtain.

3. The Greeff mount may be kept on a shelf exposed to the light indefinitely, while any gelatin mass will discolor in time.

4. Eyes preserved in formalin or Kaiserling are easier to embed and section for subsequent microscopic study, should this be at any time desired.

A method of preserving specimens for museum use was reported by Blessig and Ssolowjewa-Sakrshewskaja (*Klin. M. f. Augenh.*, p. 844, June, 1913). The eyes were first hardened in a weak formalin solution and then halved, after being frozen solid in ice. The specimens were then passed through glycerin solutions of increasing concentration (15 per cent., 25 per cent., 50 per cent.) to which a few drops of formol had been added. The eyes were preserved indefinitely with their original colors in the last solution.

Photographing macroscopic eye preparations.

After an eyeball section has been so successfully preserved and mounted that gross alterations in its tissues are readily distinguished, the question of drawing, photographing or otherwise picturing it naturally arises. Reproduction by photography is, on the whole, the most desirable and most satisfactory method. George S. Dixon (*New York Eye and Ear Infirmary Reports,* 1889) has, among others, discussed its merits as well as its principal difficulties.

A few trials convinced Dixon that photography of the gelatin-mounted specimens was not as simple as it appeared. The chief obstacle to be overcome was the light reflections from the surface of the glass cup. These produced a good picture of the glass cup, but a very poor one of the mounted specimen. After many experiments it was found that when an ordinary 3½-inch focusing glass, mounted in a metal tube, was placed over the mount, all direct rays from the surface were excluded, while the eye specimen itself was sufficiently illuminated by light entering the glass sides of the cup. Finally an apparatus was devised which Dixon regarded as the best means of obtaining plates of gelatin mounts. It consists of a pair of bellows, the anterior, a single one, being smaller than the posterior. The latter is double and carries the lens and plateholder.

This posterior bellows is securely fastened to a baseboard long enough to project considerably beyond the anterior bellows. The baseboard of the anterior bellows is fastened to a couple of cleats sufficiently high to bring the diaphragm at the back and the object in front, in the optical axis of the lens. Two smaller cleats are screwed to the long baseboard in such a manner as to allow the smaller bellows to be moved backward and forward without lateral motion, independent extension of the bellows on its own baseboard being retained.

The anterior bellows is fitted with a sliding front, in the center of which is a diaphragm sufficiently large for all specimens, varying sizes being supplied with changeable diaphragms of diameters slightly less than the interior of the macroscopic cup, for the purpose of cutting off the direct rays which would otherwise pass through the rim of the cup. This point is essential. A spring is employed to hold the cup in position. As the front slides, it can be removed from the bellows, the object adjusted as desired, and the whole returned to position, when the specimen will be in the optical axis of the apparatus.

The posterior bellows is fitted with a 3¾-inch Gundlach wide-angle lens intended to cover a lantern slide plate, and capable of enlarging an image the size of an eye two diameters with satisfactory detail; an F 32 stop should be employed during exposure.

A wide-angle short-focus Morrison lens, giving an extreme amplification of 2.6 without "breaking," is a trifle more satisfactory, but the Gundlach lens answers the purpose fairly well, as over two diameters is seldom desirable.

In the early work with this camera, diffused daylight, preferably in the open air, was employed. It was soon learned, however, that this method would only answer for a limited number of specimens, namely, those presenting a white or a very light substance in the interior of the hemisphere.

Specimens filled with dark tumors, or those in which nothing remained in the interior but retina and choroid, yielded negatives with no detail whatever in the center until the cornea and sclerotic, transparent and white, respectively, were hopelessly over-exposed. To obviate this a white bristol-board truncated cone, with an angle sufficient to throw the rays under the specimen near the center, was placed around the cup. In this instance, instead of diffused daylight, sunlight was reflected into the cone by means of a mirror. Some specimens gave good plates with this method of illumination, but the danger of over-exposing the cornea and sclerotic still remained, and an old difficulty reappeared, namely, the imperfections of the surface of the cup. But the increase in the obliquity of light brought out all the scratches on the surface of the cup, especially if a trifle over-exposed. This in turn was reduced to a minimum by cementing a perfect glass disc to the anterior surface of the cup by means of Canada balsam.

In working with direct sunlight, or the electric arc, it is important to remember that glycerin jelly becomes liquid at a temperature of 105° F.

In many instances the cornea is so transparent, and the sclerotic so white, as to require more contrast than is afforded by the porcelainized glass disc with which mounts are sealed. This is met by supplying backgrounds made of colored papers such as black, pea-green, a rather dull canary, and neutral gray. Of these, the latter color was most useful. The canary-colored background works well in some cases where it is desirable to "hold back" the sclera, but it is liable to interfere with a transparent cornea.

Color screens have not given any useful results in Dixon's hands.

On the whole, the most satisfactory plates used were Carbutt's A and B, which require exposures varying from three to twenty-five minutes, depending on the quality of the light, size of stop and character of specimen, as in all other photography.

The method is still imperfect, as will be seen. No single method of

illumination yet tried has answered for all specimens, and the color of some is such as to defy all efforts with or without color screens, with different colored backgrounds, with diffused daylight, direct sunlight, or the electric arc.

There are other methods in process of application, the most promising of which is an annular prism at the base of the cup with or without the use of the truncated cone.

PREPARATION AND PRESERVATION OF MICROSCOPIC SECTIONS OF THE OCULAR TISSUES.

[The following excellent treatise on this subject, by Dr. W. E. Fischer, is here reprinted from *Modern Ophthalmology,* through the courtesy of the author, Dr. James Moores Ball.]

When fixation is complete the specimen is to be washed in flowing water for twenty-four hours, and then is hardened in alcohol of increasing concentration. Müller's fluid enjoyed great popularity among ophthalmologists, but it has been partly superseded by formol, sublimate, and picric acid-sublimate, which are sometimes preferred. A specimen should be fixed, hardened, and stained in accordance with the peculiarities sought for.

Formol.—Formol, or formalin, is used in strengths of 4 to 10 per cent. An ordinary working solution is: Formol, 10.0; distilled water, 100.0.

The above solution fixes in from twelve to twenty-four hours.

If the eyeball be left in formol too long the lens and sclera get very hard. A 4-per-cent. strength formol solution is a suitable agent to preserve eyes which are intended for museum purposes. See **Formol-Müller fluid.**

Absolute alcohol is not a good fixing agent for the eyeball, which it shrinks too much. The finer structures are not well preserved. It answers very well where we wish to examine for tubercle bacilli or leprosy bacilli.

Erlitzki's fluid.—Potassium bichromate, 50.0; copper sulphate, 10.0; distilled water, 1,000.0.

2. *Picric acid.*—Picric acid in a concentrated aqueous solution decalcifies slowly because it does not penetrate into the tissues deeply. The same is true of picro-nitric acid.

3. *Method of Haug.*—This method is well adapted to decalcify the tissues of the eye, especially if the specimens have been fixed in formol or sublimate. Nitric acid, 3.0 to 9.0 cc.; absolute alcohol, 70.0 cc.; distilled water, 30.0 cc.; sodium chlorid, 0.25 cc.

4. *Phloroglucin method.*—Phloroglucin, 1.0; nitric acid, 5.0; alcohol, 70.0; distilled water, 30.0.

The above solution decalcifies rapidly. The time required for complete decalcification varies with the amount of calcareous material to be removed and the thickness of the specimen. To ascertain if the decalcification is complete, prick the area of the deposit with a teasing needle. After the calcareous deposit has been removed, the specimen should be washed in water for several days.

If the condition remained unnoticed until the specimen was mounted for sectioning, it should be placed in equal parts of absolute alcohol and ether to dissolve the celloidin and then should be decalcified.

Bleaching.

In order to render the examination of the minute details of some normal and pathologic ocular tissues possible, the pigment which is naturally present must be removed. Among the bleaching methods are the following:—

Hydrogen peroxid.—The celloidin sections are washed in water and are then placed in peroxid of hydrogen and are exposed to the sunlight for two or three days until they are sufficiently bleached. The sections become brittle by this process, but they will stain well.

Chlorin.—The chlorid of lime or chlorin-water may be used, but they also make the sections fragile.

Griffith's method.—Potassium chlorate, 1.0; concentrated hydrochloric acid, 2.0; distilled water, 300.0.

The mixture must be shaken from time to time and should remain in the dark.

Alfieri's method.—1. Place the sections in a potassium-permanganate solution (1 to 2,000) for twenty-four hours. When exposed to sunlight, the sections assume the brown color in less time.

2. Transfer the brown sections to a solution of oxalic acid (1 to 300), which fully bleaches them in a few seconds.

The sections will be fragile. After all bleaching processes the specimens do not stain as well as unbleached sections; hence they must be left in the stains longer.

Hardening.

After the eyeball is fixed and washed and eventually decalcified, it is ready to be hardened. Alcohol in increasing concentrations is usually employed for this purpose as follows:—

The eye is placed in alcohol: 70-per-cent. strength for twenty-four hours, 80-per-cent. strength for twenty-four hours, 90-per-cent. strength for twenty-four hours, 95-per-cent. strength for twenty-four hours, and in absolute alcohol for forty-eight hours.

For practical purposes it will suffice if the eye be placed in 70-per-cent. strength, in 90-per-cent. strength, and in absolute alcohol. The percentage of dilute alcohol need not be absolutely accurate. It may be roughly made as follows:—

70-per-cent. strength alcohol = 74 cc. of 95-per-cent strength alcohol + 26 cc. of distilled water.

80-per-cent. strength alcohol = 84 cc. of 95-per-cent. strength alcohol + 16 cc. of distilled water.

90-per-cent. strength alcohol = 95 cc. of 95-per-cent. strength alcohol + 5 cc. of distilled water.

The absolute alcohol should be changed once after twenty-four hours.

The eye is ready to be cut for mounting when it has been sufficiently hardened. The sections are cut according to the condition for which we desire to examine. The globe may be cut in quadrants (a very convenient form), one section being made in the vertical meridian and the other in the equator. If the lens is to be kept in place, the eye may be capped in a horizontal direction above and below the lens. In cases in which the displacement of the lens is a matter of indifference the bulbus may be divided in the horizontal meridian into an upper and lower half. If a tumor is present, we may divide the globe in the meridian in which the growth is situated.

Imbedding.

Celloidin imbedding.—Specimens that have been hardened and cut must be imbedded in some solid material in order to render sectioning with the microtome possible. Celloidin imbedding, proposed by Schieferdecker, was first applied for imbedding eyes by Becker, and is practically the best method. Celloidin (Schering) is obtained in sealed bottles. Thick celloidin is made by allowing a sufficient amount of celloidin to dissolve in equal parts of absolute alcohol and ether to make the fluid the consistency of thick syrup. Thin celloidin is obtained by further diluting thick celloidin with equal parts of absolute alcohol and ether until it is a thinner, less viscid fluid resembling collodion.

After the globe has been hardened and dehydrated in absolute alcohol it is placed in an absolute alcohol and ether mixture, equal parts, for twenty-four hours. It is then put in thin celloidin for from four

days to two weeks. The longer the specimen remains in the thin celloidin, the more thoroughly its tissues will be permeated by it. It is finally transferred to the thick celloidin and left in it for the same length of time, when all is ready for mounting.

For the purpose of mounting, the specimen is placed in a glass vessel deep and wide enough to allow at least one-fourth inch space on all sides. The specimen is put in the center and the thick celloidin is poured on until it rises one-fourth inch or more above the specimen. The vessel is then covered with a small bell-jar, and the alcohol or ether are allowed to evaporate very slowly in a cool place. The celloidin is permitted to harden until it has the consistency of wax: i. e., to a degree that an impression with the finger-tip (not the nail) can scarcely be made. This usually requires from two to four days, depending on the rapidity of evaporation, etc.

The firm celloidin is loosened by passing a knife along the walls of the vessel, and its contents are expelled by gently tapping on the bottom. The superfluous celloidin is trimmed off, and the specimen (inclosed in celloidin) is then placed in 70-per-cent. strength alcohol for twenty-four hours, when it will be sufficiently hardened to be mounted on a block of wood, cork, iron, or stabilit (insulating fibre) which fits the microtome-clamp. Thick celloidin is spread on one surface of the block of wood or cork and the celloidin block, with its inclosed specimen, is gently pressed on it. After ten minutes the wood and the celloidin block are immersed in 70-per-cent. strength alcohol and left in it for a number of hours, when all is ready for sectioning with the microtome.

Paraffin imbedding briefly consists of the following steps:—

1. Thorough dehydration of the specimen in absolute alcohol for from five to twenty-four hours. 2. Place in xylol for from one-half to four hours. 3. Place in xylol-paraffin (concentrated solution of paraffin in xylol) for from one to six hours. 4. Melted soft paraffin (42 degrees) for from one-half to two and one-half hours. 5. Melted hard paraffin (58 degrees) for from one-half to two and one-half hours. 6. Place the specimen in a mold and pour on 58-degree paraffin and allow to cool. 7. Mount on a block which fits the microtome-clamp.

The above method is admirable for the retina, choroid, etc., but if it be used for a globe the lens must be removed from the eye.

Paraffin sections are mounted by spreading a drop of water containing a trace of alcohol on a slide, on which the section is now laid. The slide may be warmed until the water has evaporated; or the slides may be placed in an incubator and kept at a temperature of 30° to 35° C. for from twelve to twenty-four hours. If the specimen has

been fixed in Müller's fluid, chromic acid, or osmic acid, the sections are preferably fixed on the slide with a mixture of the filtered white of an egg and an equal quantity of glycerin to which a few grains of sodium salicylate or a trace of thymol have been added to prevent the growth of fungi.

A drop of this mixture is put on the slide and the technique for mounting the section on the slide is the same as for the water with a trace of alcohol.

The paraffin must be removed from the mounted paraffin sections before they will accept any stain. This is accomplished by placing the slide on which the section has been fastened in a vessel containing pure xylol. Then the xylol should be removed with absolute alcohol; if aqueous solutions of the stains are to be used, the section is next transferred to 90-per-cent. strength alcohol, then to 60-per-cent. strength alcohol, and finally to water, when it is ready to be stained.

Cutting the Sections.

The specimen-block should be clamped firmly in the microtome. In cutting specimens that have been mounted in celloidin the microtome-knife should be set at as acute an angle as possible, in order to utilize as much of the cutting edge of the blade as we can. The knife should be drawn slowly and evenly to obtain sections free from tears and of a uniform thickness. The blade and the specimen should be kept well moistened with 80-per-cent. strength alcohol to keep the specimen from drying, and to permit the sections to float on the knife. The specimens may be washed in water and then stained, or they may be preserved in 80-per-cent. strength alcohol.

In cutting paraffin sections the knife is not placed at so sharp an angle and the sections are cut dry. If ribbon sections are to be cut, the knife is set at right angles to the direction in which it moves, and the paraffin should be quadrilateral. The sections are prevented from rolling up and are removed from the knife with a fine camel-hair brush or a delicate bristle. If the sections should be wrinkled, they may be placed in tepid water, when they will flatten out.

Nuclear Stains.

Delafield's hematoxylin.—Four hundred cubic centimetres of a concentrated aqueous ammonic-alum solution is mixed with a solution of 4 grams of hematoxylin in 25 cubic centimetres of absolute alcohol. The mixture is exposed to the light in an open vessel for three or four days;

100 cubic centimetres of methylic alcohol and 100 cubic centimetres of glycerin are then added, and the stain is allowed to mature. In a few days it is filtered and ready for use.

1. Sections are washed in water (or 1-per-cent. strength alum solution). 2. Sections are stained for from two to three minutes; if the stain has been diluted with water, ten to fifteen minutes. The section should have a light-blue tint, not an intensely dark one. 3. Wash in water until no more blue color is given off (for from ten to fifteen minutes to several hours). 4. Dehydrate in 95-per-cent. strength alcohol. 5. Clear in carbol-xylol. Balsam.

If a section has been over-stained in hemalaun or hematoxylin, the desired tint may be obtained by the following procedure: Place the over-stained section in 1/10-per-cent. strength muriatic acid until it turns red, then wash the section thoroughly in water for several hours. Should the section still be over-stained, the procedure can be repeated until the proper tint is obtained.

Alum-carmin (*Grenacher*).—Boil 1 gram of carmin in 100 cubic centimetres of a 5-per-cent. strength alum solution for twenty minutes; when the solution is cool, filter it.

1. Wash in water. 2. Stain in carmin for from ten minutes to several hours (this carmin does not overstain). 3. Wash in water. 4. Dehydrate in 95-per-cent. strength alcohol. 5. Carbol-xylol. Balsam.

Borax-carmin (*Grenacher*), *aqueous solution*.—Carmin, 0.5; borax, 2.0; distilled water, 100.0.

The above ingredients are mixed and boiled, and 5 cubic centimetres of a 5/10-per-cent. strength solution of acetic acid are added, drop by drop, while the mixture is being constantly stirred until it turns to a deep-red color. Filter the solution after twenty-four hours.

1. Wash in water. 2. Stain in carmin for from five to twenty minutes. 3. Differentiate in hydrochloric acid-alcohol (concentrated hydrochloric acid, 1.0; alcohol, 70-per-cent. strength, 100.0). 4. Wash thoroughly in water. 5. Alcohol, carbol-xylol. Balsam.

Borax-carmin (*Grenacher*), *alcoholic solution*.—The alcoholic solution is used if the sections are not to be brought in contact with water. It is prepared as follows: Carmin, 2 to 3; borax, 4; distilled water, 93.

After forty-eight hours the above solution is mixed with 100 cubic centimetres of 70-per-cent. strength alcohol. Allow the mixture to stand for thirty-six hours' time and then filter it. Nuclei stain red with this solution.

1. Transfer the section directly from 70-per-cent. strength alcohol into the alcohol-carmin and stain for from five to twenty minutes. 2. Differentiate in hydrochloric acid, 1.0; alcohol, 70-per-cent. strength,

100.0. 3. Wash in 70-per-cent. strength alcohol for several hours. 4. Dehydrate in 95-per-cent. strength alcohol. 5. Carbol-xylol. Balsam.

Lithia-carmin (*Orth*).—Dissolve 2.5 grams of carmin in 100 cubic centimetres of a cold, saturated solution of lithia carbonate.

1. Wash the sections in water. 2. Stain in the solution for from five to ten minutes. (By warming gently over the vapor of a water-bath two to five minutes will suffice.—Obersteiner.) 3. Differentiate in hydrochloric-acid alcohol as before.

Safranin (*Pfitzner*).—This is an admirable stain for specimens that have been treated with Flemming's solution. Safranin, 1.0; absolute alcohol, 100.0; distilled water, 200.0.

Dissolve the safranin in alcohol and then add the water. Stain the sections in this stain from two to twenty-four hours. If the specimens have been fixed in Flemming's solution and the sections stained with safranin and treated with acid-alcohol (8 drops of hydrochloric acid or 10 drops of a concentrated solution of picric acid to 100 cubic centimetres of alcohol), until the celloidin is colorless, the chromatin of the nuclei only will be stained. Absolute alcohol. Xylol. Canada balsam.

Karyomitotic figures are stained intensely red; the nuclei at rest are pale pink. Mucin appears yellowish red, while fibrin takes a deep-red tint.

Fuchsin (*Rubin*).—This stain is prepared and used like safranin.

Protoplasmic Stains.

The basic anilin dyes stain the nuclei, while, on the other hand, the acid anilin dyes stain the protoplasm diffusely. The latter are seldom employed alone, but are nearly always combined with a nuclear stain.

Eosin (*Fischer.*)—Eosin, 1.0; water, 100.0.

This solution may be diluted from three to five times with water.

1. Place the section in the diluted stain from three to five minutes; in some instances one minute will suffice. 2. Wash in water for a few minutes. 3. Dehydrate the sections in 95-per-cent. strength alcohol.

If the section should have been over-stained it may be left in 70-per-cent. strength alcohol until the excess of the eosin has been extracted.

One-per-cent. strength eosin in 90-per-cent. strength alcohol may also be employed. Stain the same as above with the exception that the specimen is transferred from the stain directly to alcohol.

Picric acid may be used as a counterstain in a concentrated aqueous or alcoholic solution. In certain instances it may be still further

diluted before using. Should the tissue be over-stained, the excess can be removed by washing in water or alcohol. If picric acid is used as a counterstain with hematoxylin or with hemalaun, the tissue must be slightly over-stained, as picric acid will extract them.

Orange G, in a dilute aqueous solution (1-per-cent.), stains the protoplasm light orange.

Acid fuchsin (*Fuchsin S., Rubin S.*) is used as a concentrated aqueous solution, or it is dissolved in anilin-water. It readily over-stains, and this fault cannot be remedied.

Double Stains.

The following combinations of nuclear and protoplasmic stains produce good results:—

Hemalaun or hematoxylin and eosin.	Carmin and orange G.
Hemalaun or hematoxylin and orange G.	Carmin and picric acid.
Hemalaun or hematoxylin and picric acid.	Safranin and picric acid.

Hemalaun-eosin is a durable stain and the best for all practical purposes.

1. Stain in hemalaun for from five to ten minutes (see **Hemalaun**). 2. Wash in water for from ten to thirty minutes. 3. Stain in a diluted 1-per-cent. strength aqueous solution of eosin or in an alcoholic solution for from one to five minutes. (The alcoholic solution is composed of: eosin, 0.1; alcohol, 90-per-cent. strength, 100.0.) 4. Wash in water for a few minutes. 5. Alcohol, 95 per cent. Should the specimen be overstained in eosin, it may be placed in 70- to 80-per-cent. strength alcohol until sufficient eosin has been extracted to give the section a rose-red tint. 6. Carbol-xylol. 7. Balsam and cover-glass.

Van Gieson's stain is a beautiful tricolor stain, but unfortunately it is not always permanent.

1. Overstain section in hematoxylin for from fifteen to thirty minutes. 2. Wash thoroughly in water. 3. Stain for from one to three minutes in a concentrated aqueous solution of picric acid, to which sufficient aqueous concentrated solution of acid fuchsin has been added to give a deep-red color. 4. Wash in water for one-half minute. 5. Alcohol, with a trace of picric acid. 6. Carbol-xylol. Balsam.

The above is an admirable stain for the optic nerve. With this stain colloid bodies assume an orange-red tint, while hyalin bodies are bright-red.

Weigert's stain for medullary nerve-sheaths.—Specimens that have been fixed in Müller's fluid, Erlitzki's fluid, or 5-per-cent. strength

potassium-bichromate solution are not washed, but are rapidly hardened in alcohol, imbedded in celloidin, and sectioned.

The sections are placed in: Saturated solution of neutral copper acetate, 50.0; distilled water, 50.0; for from twelve to twenty-four hours.

They are then transferred to a solution composed of: (a) Hematoxylin, 1.0; absolute alcohol, 10.0; (b) Lithia carbonate, 1.0; distilled water, 100.0; where they remain for from twenty minutes to twenty-four hours. It is preferable to keep the solutions a and b separate or mix the quantity one wishes to use in the proper proportions immediately before staining.

When the sections are black they are washed and differentiated in: Borax, 2.0; ferricyanid of potassium, 2.5; distilled water, 100.0.

The latter solution may be diluted with water to one-half strength, so that the process of differentiation may be better controlled. If the staining is successful, the nerve-sheaths will appear dark blue, the degenerated areas, as well as the remaining tissue, light brown. Blood and fibrin often take a dark-blue tint.

Method of Marchi.—1. Fix in Müller's fluid for at least eight days. 2. Transfer to a freshly prepared mixture of equal parts of Müller's fluid and osmic acid for from six to twelve days. 3. Wash in flowing water for twenty-four hours. 4. Harden in alcohol; celloidin. Section with the microtome. 5. Stain the sections in lithia-carmin for contrast. Degenerated areas appear black, everything else light yellow. Other methods are those of Paland Kulschitsky. For their execution the reader is referred to the special works of Greeff or Seligmann.

Dehydration of the Sections.

Paraffin sections are placed in 60-per-cent. strength alcohol for a few minutes, then in 90-per-cent. strength alcohol, and finally in absolute alcohol.

Celloidin sections are dehydrated in 95-per-cent. strength alcohol, since absolute alcohol dissolves the celloidin. If the celloidin has stained as intensely as the tissue,—for instance, after staining with anilin dyes,—it may occasionally be necessary to remove the celloidin. This is accomplished as follows: The section is treated with absolute alcohol for about five minutes and then is placed in a mixture of absolute alcohol and ether (equal parts) for from ten to fifteen minutes. Oil of cloves will also dissolve the celloidin, but it must be removed again by pure xylol.

Clearing the Sections.

Paraffin sections that have been thoroughly dehydrated with absolute alcohol are then treated with xylol, in which they will clear in a few minutes.

Celloidin sections that have been dehydrated only in 95-per-cent. strength alcohol are preferably placed in carbol-xylol for clearing. Carbol-xylol is an excellent clearing agent, and is prepared as follows: Pure xylol, 45.0; crystallized carbolic acid, 15.0.

In place of xylol or carbol-xylol, origanum-oil, oil of bergamot, oil of cedar, or oil of lavender may be employed. Oil of cloves is rarely used for the purpose of clearing celloidin sections, as it dissolves the celloidin and extracts most of the anilin dyes.

Mounting the Sections on Slides.

After a celloidin section has been cleared it is spread smoothly on the slide. When all wrinkles have been brushed out with the teasing needle, the clearing medium is blotted off by firmly pressing the section to the glass with several layers of fine filter-paper. Now put 1 drop of Canada balsam on the section and place the cover-glass on it.

For paraffin sections the process is the same, with the exception that the section is fixed to the slide and the process is carried out on the slide.

Sections that are not to be brought in contact with alcohol after they have been stained are mounted permanently in glycerin. The section is placed on the slide, the water is blotted with filter-paper, and then 1 drop of glycerin is put on the section, when the cover-glass is gently placed on it.

In order to keep such a preparation permanently the edges of the cover-glass must be fastened to the slide by rimming the cover-glass with cement. Superfluous glycerin about the edges of the glass must be removed with cotton moistened with alcohol. The cover-glass may be fastened to the slide by painting the edges with melted paraffin over which a coat of asphalt varnish is then applied. Kroenig's cement may be also used.

Demonstration of Definite Substances and Tissue-Elements.

Nuclear and protoplasmic structures.—(A) *Nuclear structures.*—(a) Flemming's solution. (b) Sublimate or formalin fixation should be used. This method is applicable for demonstrating the structure

of the nucleus. Fix in Flemming's solution and imbed in paraffin. 1. Stain in safranin. 2. Stain in a 2-per-cent. strength gentian-violet solution. Differentiate as with the safranin. 3. Gram's method—Anilin-water and gentian-violet (from three to five minutes). Treat with a solution of iodin, 1.0; potassium iodid, 2.0; water, 300.0, for from one to two minutes. 4. Decolor in absolute alcohol. 5. Stain in carbol-fuchsin: Five-per-cent. strength aqueous carbolic-acid solution, 100.0; fuchsin, 1.0; alcohol, 10.0. Stain in this solution for one-half hour, then rinse in 90-per-cent. strength alcohol. 6. Wash in hydrochloric acid-alcohol or 1-per-cent strength picric-acid solution for from one-half to two hours. 7. Wash in absolute alcohol until only slight stains are imparted to the alcohol. Clear in xylol. Balsam.

Karyomitotic figures are intensely red; nuclei at rest have a pale-red tint.

(B) *Protoplasmic structures.*—Altmann recommends the following method for the demonstration of the granules in the cell:—1. Fixing in a solution of: Five-per-cent. strength potassium bichromate, two-per-cent. strength osmic acid, of each, equal parts. 2. Wash in water and harden in alcohol of increasing concentration. 3. Imbed in paraffin. Cut sections two to five micromillimetres. Mount and remove paraffin. 4. Stain in a solution of: Anilin-water, 100.0; acid fuchsin, 20.0. Warm until the solution begins to steam. 5. Allow to cool and remove the surplus of the stain with a mixture of: Concentrated alcoholic solution of picric acid, 1.0; water, 2.0. Renew the picric-acid mixture and keep the same at a temperature of 42° C. for from thirty to sixty hours. Wash in absolute alcohol, xylol and balsam. The red granules are easily recognized in the pale-yellow cell-body.

Elastic fibres.—Method of Weigert.—One-per-cent. strength aqueous solution of fuchsin rubin, 100.0; two-per-cent. strength aqueous solution of resorcin, 100.0; are mixed in a porcelain dish and brought to the boiling point. To this solution are added 25 cubic centimetres of liquor sesquichlorati (Ph. G.) and the mixture is boiled for two or three hours. A precipitate is formed. The solution is allowed to cool and is then filtered; the filtrate is rejected. The precipitate on the filter-paper is now boiled in 200 cubic centimetres of 94-per-cent. strength alcohol; the solution is again allowed to cool, and finally is made up with alcohol to 200 cubic centimetres; 4 cubic centimetres of hydrochloric acid are added, whereupon the stain is ready for use.

Liquor ferri sesquichlorati is made as follows: 1 part of iron is dissolved in 4 parts of hydrochloric acid, and then there are added, for every 100 parts of iron dissolved, 260 parts of hydrochloric acid and 135 parts of nitric acid.

1. Stain the section in carmin. 2. Differentiate in hydrochloric acid-alcohol. 3. Wash in alcohol. 4. Now stain the sections in Weigert's elastic-fibre stain for from twenty minutes to one hour. 5. Dehydrate in absolute alcohol. 6. Clear in pure xylol. Balsam.

By staining the nuclei with carmin first, and then staining the protoplasm with orange G later, the effect of the stain will be heightened. The elastic fibres appear dark blue or almost black. Another stain for elastic fibres is that of Unna-Taenzer.

Fat and fatty degeneration.—Fat is stained intensely black by osmic acid. Flemming's solution may be used for fixation. In preparations that have been hardened in formol, the degenerative processes may be demonstrated as follows: 1. Transfer the specimen from formol into Flemming's solution. 2. Place the sections in $\frac{5}{10}$-per-cent. strength chromic acid for three hours, then for twenty-four hours in 1-per-cent. strength chromic acid. 3. Stain in hematoxylin solution and wash in a saturated solution of picric acid. The cell-granules are blue, while the remainder is stained green (Busch).

The fat-granules within the cells have the following properties:—

1. They do not disappear when acetic acid is added. 2. They are resistant to the treatment with 1- to 3-per-cent. strength solutions of potassium and sodium hydrate. 3. They are blackened by the addition of a 1-per-cent. strength osmic acid. 4. The smallest droplets are stained intensely violet by iodin-violet. 5. They are soluble in chloroform and ether.

Fibrin.—Fibrin stains with the acid anilin dyes; picric acid, eosin, and acid fuchsin. Weigert has devised a special stain for fibrin.

Cholesterin.—Cholesterin crystals are generally found in masses of fatty detritus. They are frequently found in the degenerated vitreous, in subchoroidal and subretinal exudations, and in the anterior chamber. Cholesterin is soluble in alcohol and ether; hence the crystals are not visible in sections that have been obtained from specimens hardened in paraffin or in celloidin. They leave characteristic clefts and gaps if they were present. When treated with Lugol's solution (iodin, 1.0; potassium iodid, 1.0; water, 100.0), the crystals become dark brown. By adding a few drops of a 30- to 40-per-cent. strength sulphuric acid they will become gradually blue-red, blue-green, and finally blue.

Calcareous degeneration.—Calcareous deposits occur in cells as well as in the ground-substance. The lime deposited in the tissues in the form of granules or clumps appears white and glittering when seen by reflected light; when examined by transmitted light, it appears dark. By the addition of hydrochloric acid (permitted to flow in from

the edge of the cover-glass), the calcium carbonate is dissolved, with the liberation of carbon-dioxid gas, while the calcium phosphate is dissolved without. By adding sulphuric acid gypsum crystals are formed. Lime takes a characteristic blue stain with alum hematoxylin; sometimes it is reddish blue.

By Leutert's method the slightest traces of lime can be demonstrated as follows: 1. Staining sections not imbedded in paraffin in concentrated alcoholic solution of hematein (for fifteen minutes). 2. Wash in flowing water for fifteen minutes. 3. Stain further, in a 1-per-cent. strength solution of safranin (for from five to eight hours). 4. Rinse in water. 5. Differentiate and dehydrate in alcohol, oil, and balsam.

The lime is stained deep steel-blue and the nuclei intensely red. The sections are not permanent.

Mucoid degeneration.—There are some cells in the normal conjunctiva which contain mucin. In inflammatory processes of this membrane, and on the surface of papillomata, we find them in great numbers. If the specimen has been stained with carmin, the mucin in the cell-body will remain unstained and the goblet-cells appear as light spaces in the epithelium. The nucleus at the bottom of the cell only is stained red. The mucin also is not stained by dilute solutions of hematoxylin, but it stains diffusely blue with the concentrated solutions of hematoxylin; so that the nuclei are difficult to discern.

Acid fuchsin stains the mucin intensely red, safranin stains the mucin orange-red, and methylene blue stains the mucin blue. The following is a very good method: 1. Fix in a concentrated aqueous solution of corrosive sublimate for from two to eight hours. 2. Rapidly harden and dehydrate in absolute alcohol. 3. Imbed in celloidin or, preferably, in paraffin. 4. Place in a concentrated aqueous solution of corrosive sublimate for half a minute the sections from which the paraffin has been removed. 5. Rinse in alcohol. 6. Stain in a dilute solution of thionin (2 drops of a saturated solution of thionin to 5 cubic centimetres of water). 7. Rinse in alcohol, 90-per-cent. strength. 8. Rapidly dehydrate in absolute alcohol. 9. Clear the section in a mixture of oil of cloves, 1 part, and oil of thyme, 5 parts. 10. Oil of cedar. Balsam.

Other and more permanent stains are mucicarmin and the mucihematein of P. Meyer.

Hyalin and colloid degeneration.—Hyalin and colloid substances are characterized by their high refractive power. They are comparatively insoluble albuminous substances which occur very frequently in the various structures of the eye. They are found physio-

logically in advanced age and also in chronic inflammatory processes. For fixation formal-Müller fluid or alcohol may be used. The substances stain well with the acid anilin dyes (eosin, acid fuchsin, and picric acid). With the Van Gieson stain these bodies are colored a brilliant red. Bismarck-brown gives them a light-brown tint. As a nuclear stain hematoxylin may be used.

Amyloid degeneration.—Amyloid is very resistant to alkalies, acids, etc. Formol, sublimate, alcohol, and Müller's fluid may be used to fix. Hematoxylin, eosin, or the Van Gieson-Ernst stains are good. With the former the amyloid substance stains pink; with the latter, pink to red-brown. Besides these there are several specific stains, viz.:

1. Iodin reaction.—The sections are placed for from three to ten minutes in Lugol's solution diluted with 3 parts of water. The sections are then washed and examined in glycerin. The degenerated areas are stained brownish-red, while the unaffected tissue is yellow. The brownish-red color is rendered still more brilliant if 25 per cent. of glycerin is added to the solution. This stain is not permanent.

2. Iodin and sulphuric-acid reaction.—If a section has been treated as mentioned above, and is then placed in a 1-per-cent. strength solution of sulphuric acid, the brown color will become more saturated, or become violet, blue, or greenish. Sometimes some of these colors can be seen with the iodin treatment only.

3. Methyl-violet and gentian-violet reactions.—This reaction is not absolutely reliable, as mucus may be also stained with this method. The procedure is as follows: 1. Stain for from one-half to fifteen minutes in a 2-per-cent. strength solution of methyl-violet or in a gentian-violet solution. 2. Wash in a 2-per-cent. strength solution of acetic acid or in a 1-per-cent. strength solution of hydrochloric acid for from two to three minutes. 3. Rinse thoroughly in water. 4. Imbed in glycerin, in a concentrated solution of potassium acetate, or in levulose. The cover-glass should be rimmed if the section is to be permanent.

The amyloid areas become purple-red; the remainder of the tissue takes a blue tint.

4. Thionin stain.—1. Stain in a concentrated aqueous solution of thionin for five minutes. 2. Wash in distilled water. 3. Dry on the slide with blotting-paper. 4. Dehydrate and clear with anilin oil-xylol (2 to 1). 5. Pure xylol. Canada balsam. Amyloid stains bright blue or lilac; the unaffected areas stain bluish or violet.

Corpora amylacea.—This is a local condition which manifests itself in foci of degeneration or amyloid concretions, having a spheric outline, and are fifteen to twenty-five micromillimetres in diameter. They

are found in the prostate, the brain, the optic nerve, the chiasma, and the optic tract. Sometimes they are found as far back as the corpora geniculata externa and the optic thalami. The amyloid concretions are most frequently found in ascending atrophy after phthisis bulbi. They usually give the amyloid reactions with iodin and acids. When treated with Lugol's solution, they appear brown or violet; the surrounding tissue is yellow. When stained with Lugol's solution and treated with an acid, they become violet. When these concretions are found in old corneal scars, the specimen has been fixed in Müller's fluid, and the section is stained with hemalaun hematoxylinalum-carmin, they appear yellow. In the optic nerve they stain blue with hematoxylin and hemalaun, and red with alum-carmin.

Glycogen.—The demonstration of glycogen is of little value to the ophthalmologist. The method of Langhans will be mentioned here, which is also of value in staining amyloid, and is as follows: 1. Stain in Lugol's solution (for from five to fifteen minutes). 2. Dehydrate in a solution composed of tincture of iodin, 1.0; absolute alcohol, 4.0. 3. Clear and preserve the specimen in origanum-oil by rimming the cover.

BACTERIOLOGIC EXAMINATION OF OCULAR TISSUES AND DISCHARGES.

The technique of the various methods now in use is described under **Bacteriology of the eye,** on pp. 763-774, Vol. II of this *Encyclopedia.* See, also, **Direct smear.**

Labrador tea. LEDUM PALUSTRE. Wild rosemary or swamp tea contains ericolin and a volatile oil. It is a narcotic and used in whooping cough. It has been noticed that full doses of an infusion of the whole plant have produced vertigo, confusion of the senses, headache and marked dilation of the pupil.

Labyrinthine ophthalmostatics. See **Nystagmus.**

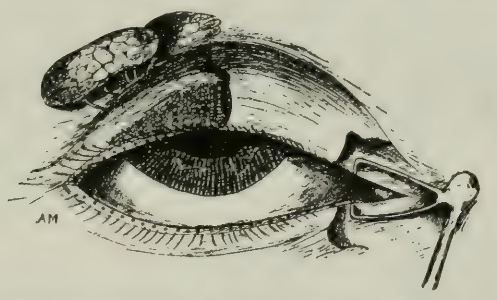
Lac. (F.) Sinus.

Laceration of secondary cataract. This term was applied by Henry Noyes to a method devised by him in 1869 for operating on capsular and secondary cataracts. A cataract knife is introduced through the horizontal meridian of the cornea, as in the operation of flap extraction. The point of the knife is then partially withdrawn, the handle is elevated and a long, vertical wound made in the membrane. The knife is then entirely withdrawn, two blunt hooks are introduced through the points of entrance and exit in the cornea, and the opening in the membrane widened by pulling on the two sides in opposite directions. See, also, **After-cataract.**

Lace-wing flies. These members of the order Neuroptera are remarkable for their delicate wings and brilliant eyes, one of them being the golden-eyed fly.

Lachrym—. For the majority of words so beginning, see **Lacrim—.**

Lacrimal (lachrymal) apparatus. The anatomy, physiology, pathology and therapeutics of this important portion of the eye have, in part, been discussed and illustrated under various captions in this *Encyclopedia;* and these should be consulted in connection with this section. In particular, the reader is referred to the sub-sections dealing with the lacrimal organs and canals in **Anatomy of the eye**; **Histology of the eye**; **Development of the eye**; **Comparative anatomy**; **Cavities, Neighboring**; **Congenital anomalies**; **Bacteriology of the eye**; as well to pp. 3707-3732, Vol. V of this *Encyclopedia,* where many **Dacryo-** rubrics are discussed.



Lacrimal Apparatus. Lacrimal Gland, Canaliculi and Sac. Meibomian Glands and Orifices.

ANATOMY OF THE LACRIMAL APPARATUS.

Lacrimal gland. In addition to the description (and illustrations) on the pages beginning with p. 350, Vol. I, and p. 5967, Vol. VIII of this *Encyclopedia,* it may be said here that this organ is a pinkish body consisting of an upper, or major, and lower, or minor, portion lying in the *fossa lacrimalis.* It measures in the adult about 15 mm. in length, 4.5 mm. in width and 7 mm. in depth. The *glandula superioris* or *orbitalis* is the larger portion, which occupies the entire fossa and is supported by trabeculæ from the orbital periosteum. The *glandula inferioris* or *palpebralis* is smaller, is attached loosely to the under surface of the superior portion and lies immediately above the upper, outer fornix conjunctiva. The component cells are separated and held together by septa of connective tissue. Both parts have the same structure, being serous and exactly resembling serous salivary

glands. Maziarski has shown that they are not acinous, nor tubulo-acinous, but tubular. In the new-born child they have no adenoid tissue; in the adult, on the contrary, there is a large quantity between the gland tubules.

Fig. 1.

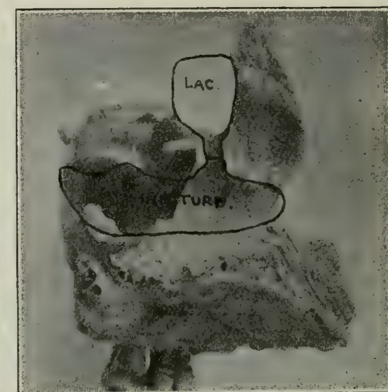


Fig. 2.

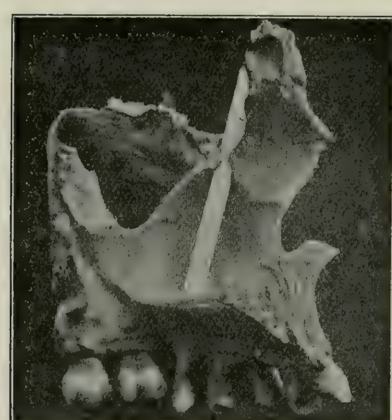


Fig. 3.

Fig. 4.

The Naso-Lacrimal Canal. (S. E. Whitnall.)

Left maxillæ viewed from nasal side. Figs. 1, 3, 4, illustrate different degrees of formation of medial wall of naso-lacrimal canal by approximation of lips of sulcus lacrimalis. Fig. 2 shows in outline completion of this wall by descending process of lacrimal bone articulating with lacrimal process of inferior turbinated bone.

The *glandulæ mucosæ* (Krause's glands), situated in the superior and inferior fornices, are similar in structure and accessory in function to the gland proper.

The *ligamentum suspensorium glandulæ lacrimalis* is a broad, fibrous band connecting the periosteum with the upper temporal surface of the gland.

The *excretory ducts* of the lacrimal gland are three to five in number, and are ½ mm. in diameter. They convey the tears from the superior lacrimal gland into the superior cul-de-sac. They pass between the tubules of the inferior gland, receive their secretion and then empty four to five mm. from the superior tarsal border.

The *fossa glandulæ lacrimalis* is a bony depression in the upper anterior temporal angle of the roof of the orbit, measuring in the adult 15 mm. in length, 4.5 mm. in width, and 7 mm. in depth. It receives the greater mass of the gland. Zabel (*Anat. Hefte. Merkel u. Bonnet,* I, 15, p. 153, 1900) notes that in some skulls where the lacrimal bone is rudimentary or absent, the lacrimal fossa is shallow and reduced, and the naso-lacrimal canal narrowed transversely. S. E. Whitnall (*Ophthalmoscope,* Oct., 1912) found in twelve skulls that seven presented shallow lacrimal fossæ with markedly narrow naso-lacrimal canals. He especially noticed that narrowing of the naso-lacrimal canal is specially prone to occur in those cases where it is almost entirely formed by the meeting of the edges of the sulcus lacrimalis of the maxilla.

The lacrimal gland is developed from solid ingrowths of the surface or ectodermic cells. It is well advanced long before the birth of the child, but its function (the secretion of tears) is not established until from one to six weeks after birth. Cirincione (*Graefe's Archiv,* 69, 2) points out that the lacrimal gland is first observed in the human embryo of 32 mm., i. e., about the 70th day or 10th week of its development. It begins with 5 or 6 proliferations of the conjunctiva. These proliferations occur one after another, but within a very short interval (in less than a day). They uniformly appear in the upper portion of the outer fornix of the conjunctiva at its junction with the palpebral conjunctiva. At first these proliferations have the appearance of buds. This stage is, however, quite short, lasting only a few hours; in embryos of 34 mm. all the buds have already changed into clubs. The club stage lasts a few days, corresponding to the growth of the embryo from 34 to 37 mm. During this time the club grows exclusively in a longitudinal direction, and remains a solid protuberance without a central lumen. The first branchings of these five primordial protuberances are observed in embryos of 38 mm. Further proliferations of the fornix, five to eight in number, follow the first in embryos of 40 to 60 mm.; their growth, however, is slow, and they show the first sign of branching in embryos of 54 mm. only.

The differentiation of the gland into two portions begins in embryos of 38 mm. The lateral expansions of the tendon of the levator and Tenon's capsule, which begin in embryos of this size, contribute a few fibres to the formation of a fibrous septum placed along the glandular protuberances and dividing the latter into two unequal parts: the glandular buds which later grow out from the conjunctiva make a halt in their development in front of the septum. In embryos of 60 mm. the division of the gland is completed; the orbital portion is formed exclusively by the branchings of the older (the first 5 or 6) primordial tubes behind the interglandular septum. The palpebral portion is formed by the branchings of the same tubes in front of the interglandular septum, and further, by the branchings of those primordial tubes which have developed later and did not grow beyond this portion.

The structure of the glandular tubes resembles in its first period (club-shape) that of every other embryonal proliferation of the ectoderm: large compressed polyhedric elements with a round nucleus and homogeneous protoplasm. It begins to have an individual appearance when the central elements dissolve so as to leave a free lumen (real tube). This takes place in embryos from 50 mm.; the wall of the tube after the formation of a central lumen consists of two distinctly different layers of cells,—the one layer of secreting cells, the other that of the basal cells. (*Ophthal. Review* abstract.)

Lacrimal puncta and canaliculi. These organs have already been described and depicted on p. 351, Vol. I of this *Encyclopedia.*

In the *development of the canaliculi* the fissure between the spheno-nasal process and the maxillary process marks the course, in the fetus, of the naso-lacrimal groove. With the development of the nose the median end of the tube becomes more deeply-seated. The upper end broadens and becomes bifurcated by an ingrowth of mesodermic tissue, forming the lacrimal canaliculi and ending on the margins of the lids to form the puncta lacrimalia. Shortly before birth the cells occupying the center of the cylinder disintegrate and disappear, establishing the lumen of the canaliculi, sac and canal.

The lacrimal sac. This receptacle for the tears prior to their passage into the duct, lies at the nasal end of the canaliculi and superior extremity of the nasal duct, in a fossa or groove formed by the lacrimal bone and the nasal process of the superior maxillary bone. It is oval in shape, closely adherent to the periosteum, composed of fibrous elastic tissue and lined with mucous membrane, closed above and opening below into the duct. It measures 8 mm. in width in its widest portion, and 12 mm. in length. See, also, p. 351, Vol. I of this *Encyclopedia.*

The *naso-lacrimal canal* is formed in greater part by the *sulcus lacrimalis* of the maxilla, the gap between the lips of which on the medial or nasal side being completed normally by the descending process of the lacrimal bone above articulating with the lacrimal process of the inferior turbinated bone below. The extent to which these two processes take part in the formation of the medial wall of the canal is variable and is compensated by the degree of development of the lips of the *sulcus lacrimalis.*

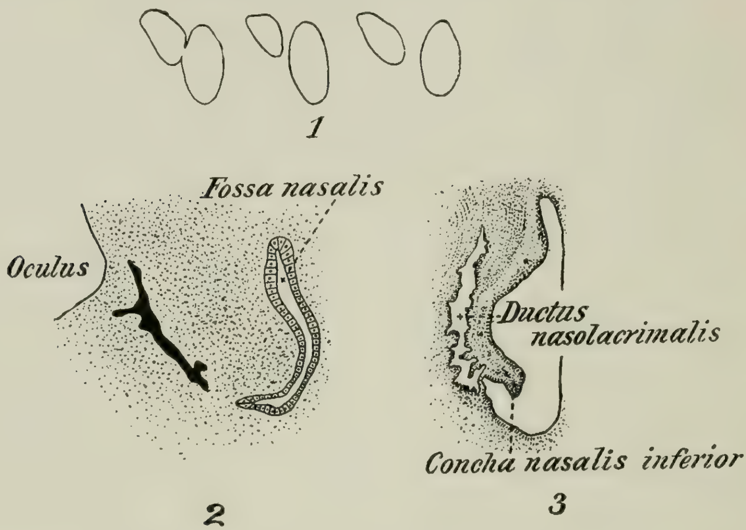
Aubaret and Bonnefon (*Archives d' Ophtalmologie,* Aug., 1910) found that usually the sulcus forms about three-quarters of the circumference of the canal, bounding it on the posterior, lateral, and anterior aspects, as well as forming part of its medial wall. Here the edges of the sulcus are separated by an interval of about 4 mm., which shows the condition found in thirty-one specimens out of fifty adult European maxillæ examined, and which consequently may be taken to represent the more common type. The anterior lip (*margo lacrimalis*) of the sulcus forms a much greater part of the medial wall of the canal than does the posterior lip (*lunula lacrimalis*) and may help to form a deep bay curving forwards from above downwards in which the naso-lacrimal duct is lodged. The canal in these cases is always roomy (an antero-posterior diameter of about 8 mm. was found in the centre of several) and there is nowhere any marked narrowing of the calibre.

In a less number of specimens examined (twelve out of fifty) the lips of the sulcus approached one another more closely, to within 1 or 2 mm., thus forming a greater part of the medial wall of the canal, the amount contributed by the lacrimal and inferior turbinated bones being reduced in consequence. The canal in these cases was a little less roomy than in the former, but, again, no definite narrowing of the lumen was noted.

In seven instances out of the fifty, the lips of the sulcus met and fused, and the central part of the canal was formed entirely by the maxilla, leaving only a small part of the medial wall above to be completed by the lacrimal bone. This wall was ridged right across by the crista lacrimalis with which the inferior turbinated bone articulated. The feature of particular interest is that whilst in six of these seven bones the canal, as a whole, was much narrower than in the other specimens, no less than four presented a decided constriction of the lumen in the central part of the canal, which measured 3 mm. in diameter. In one case the condition was found in both maxillæ of one skull. Whilst the naso-lacrimal duct enclosed in such a narrowed

canal may have been pervious, it is obvious that a slight cause would lead to its occlusion.

Although fifty is a small number of specimens to base statements upon in the case of such an extremely variable structure as the naso-lacrimal canal, and although it may be unjustifiable to draw any distinction between the first two groups described above on account of possible damage to the fragile lips of the sulcus in the preparation of



Embryological Relations of the Naso-lacrimal Duct.

Fig. 1. Outlines of the lumen of the ductus naso-lacrimalis at various levels. What appears to be two ducti naso-lacrimales lying side by side at one level turns out to be the main duct and a diverticulum from it. From an adult.

Fig. 2. Frontal section through the nasal fossa of a forty-day human embryo. The anlage of the naso-lacrimal passages is indicated in solid black. Note its complete isolation from its former surface connection. Note a few lateral buds from the mother cord of cells, presumably the proton of diverticula. At the ocular end of the cord the lacrimal ducts are beginning to sprout.

Fig. 3. Showing the irregular canalization of the ductus naso-lacrimalis, from a term child. (J. Parsons Schaeffer.)

the bone, yet in view of the fact that in all those cases (forty-three) where the lips of the sulcus did not meet, no definite narrowing of the canal was found, whilst it existed to a marked degree in six out of seven bones where the lips did meet, it seems permissible to conclude that narrowing of the naso-lacrimal canal is specially prone to occur in those cases where it is almost entirely formed by the meeting of the edges of the sulcus lacrimalis of the maxilla.

Diverticula of the lacrimal duct. It is generally believed that the walls of the naso-lacrimal duct are regular and that the lumen of the

duct represents a more or less uniform cylinder. The common practice of passing the lacrimal probe would also lead one to think that the naso-lacrimal duct has even or regular walls. Admittedly, such a condition does obtain in a certain percentage of cases and represents one of the anatomic types of the naso-lacrimal duct (Fig. X). On the other hand, recent investigations by the writer indicate that many naso-lacrimal ducts present lumina of very irregular contour, some even more or less tortuous in course. The irregularity and complexity of the lumen of the naso-lacrimal duct is at times carried to a marked degree (Fig. X).

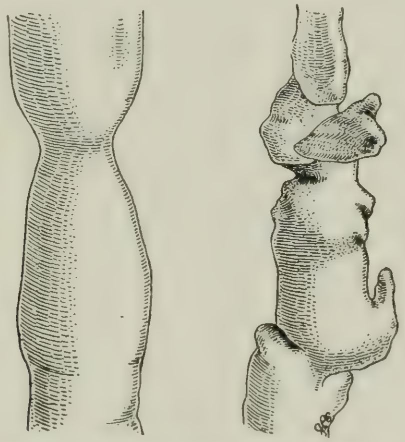


Fig. X. Showing outline of reconstructions of lumina of mid-portion of two adult naso-lacrimal ducts. One is very regular, the other very irregular and with diverticula. (J. Parsons Schaeffer.)

Minor irregularities are at times due to mere folds in the mucous membrane. In many instances, they are of little moment, again, they may form definite bridges along the walls of the duct.

In some instances two parts of the naso-lacrimal duct are not in exact line and the connection between the parts a somewhat deviating cross-channel. Finally, many naso-lacrimal ducts present very irregular lumina due to diverticula.

These diverticula vary from those of an insignificant size to those with relatively large dimensions. The diverticula are obviously direct extensions of the walls of the duct proper. They are lined with a mucosa similar to that lining the main duct, and at the ostia of the diverticula the mucosæ of the main duct and diverticula are directly continuous, both grossly and histologically.

In studying cross-sections of the naso-lacrimal duct, one is at times puzzled to explain what are apparently two ducts lying side by side.

However, by following the sections serially one finds that the one cavity sooner or later communicates with the other, i. e., one turns out to be the naso-lacrimal duct proper, and the other merely a diverticulum from it (Fig. 1).

These diverticula must be very important clinically and they need further study. Owing to the irregularity of the lumen in many instances of the naso-lacrimal duct, it is obvious that false passageways are repeatedly made by operators when they pass the lacrimal probe.

Genetically, naso-lacrimal duct diverticula are doubtless the result of irregular canalization in fetal life of the solid cord of epithelial cells from which the several naso-lacrimal channels develop. One must, therefore, return to the embryologic stage of the naso-lacrimal duct for a proper genetic interpretation of the naso-lacrimal duct diverticula.

After the strand of thickened epithelium (the anlage of the naso-lacrimal passages) along the floor of the now rudimentary naso-optic groove becomes entirely isolated from its surface connection it becomes entirely surrounded by mesenchymal tissue and is for a time without a lumen (Fig. 2).

This epithelial cord becomes canalized in a very irregular manner. In this canalization, one has direct evidence of the earliest stages of naso-lacrimal duct diverticula. Small, lateral pouchings from the main channel, due to a re-arrangement of epithelial cells, are early in evidence. Para passu with the growth of the main duct, the diverticula increase in size. At times one finds direct side branches from the mother cord of epithelial cells and some of them doubtless represent the proton of diverticula (Fig. 2).

It must, therefore, be concluded from the evidence at hand at present that the diverticula from the ductus naso-lacrimalis are of congenital origin and are not acquired in later life. (J. Parsons Schaeffer in the *Anatomical Record,* Vol. 9, No. 1, Jan., 1915.)

According to Aubaret (*Arch. d' Ophtal.,* Aug., 1910) the *anterior ethmoidal cells,* which, as usually described, do not come into close connection with the nasal duct, may extend forwards so as to be in close contact with the upper part of the nasal duct, not only posteriorly, but mesially, and even in front of it. They never exist on its temporal aspect. Thus the upper nasal duct may be enveloped on three sides by ethmoid cells, so that the transference of disease from the one to the other may be readily effected. Some anatomists find very great difficulty in understanding how it is that ophthalmic surgeons can pass probes down the nasal duct without penetrating the middle meatus. If we remember this it makes us very chary about

using probes in these cases, for there might readily exist this special relation to anterior ethmoidal cells.

S. E. Whitnall (*Ophthalmic Review*, p. 324, Nov., 1911) has shown that in 100 skulls examined, approximately the inferior half of the lacrimal fossa was found in every case related solely to the anterior part of the middle nasal fossa, which could easily be entered through the thin posterior portion of this area formed by the lacrimal bone, whilst the superior half of the lacrimal fossa presented relations to an

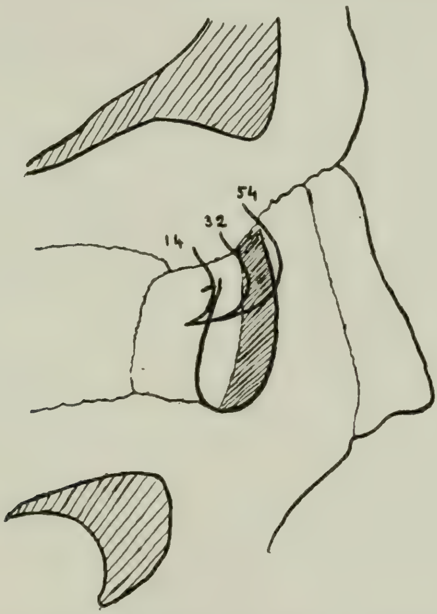


Diagram showing various relations of an anterior ethmoidal cell to upper part of lacrimal fossa, the maxillary portion of which is shaded. The figures show the percentages of cases in 100 skulls examined. (Whitnall.)

anterior ethmoidal cell which extended (i) to the posterior wall of the fossa in 14 cases; (ii) as far forwards as the centre of the medial wall in 32 instances; (iii) completely across behind the fossa in 54 cases. Thus the thin posterior lacrimal portion of the upper half of the fossa was related to an ethmoidal cell to a varying extent in every case. There was in most cases a single ethmoidal cell situated in the anterior extremity of the uncinate process of the ethmoid bone, in the region of the agger nasi. This cell opened into the ethmoidal infundibulum. The difference in strength between the anterior half of the lacrimal fossa formed by the stout frontal process of the maxilla and the posterior half formed by the delicate lacrimal bone was pronounced even when the former was also undermined by ethmoidal cells.

See, also, the illustration on p. 1820, Vol. III of this *Encyclopedia.*

The *lacrimal nerve* is one of the terminal branches of the superior or ophthalmic branches of the fifth pair. It passes directly to the gland from which it sends branches to the conjunctiva and skin of the lid. In the gland branches are given off which supply the upper, outer portion of the conjunctiva. Branches pierce the external palpebral ligament and pass to the integument of the upper eyelid anastomosing with branches from the facial nerve. The gland also receives fibers from the seventh pair.

The lacrimal fibers are supposed to run from the nucleus of the glosso-pharyngeal nerve, through the *pars intermedia Weisbergii,* into the root of the facial nerve with which it leaves the brain. The fibers then leave the geniculate ganglion by the great petrosal, and connect with the spheno-palatine ganglion, thus joining the fifth nerve. From the spheno-palatine ganglion the tract connects with the lacrimal nerve directly, and indirectly through the Gasserian ganglion.

The *secretion of tears* is brought about by the sympathetic nerve through its effect on the blood-supply to the gland. Through the nasal nerve an intimate relationship exists with the iris, ciliary body and choroid, through the long and short ciliary nerves. Through the infratrochlear branch of the nasal it is in relationship with the mucous membrane of the turbinals and nares, the conjunctiva, the caruncle, lacrimal ducts and sac. The connections explain the lacrimation which occurs with all irritations of the anterior segment of the bulb, of the lacrimal ducts or the nasal mucous membranes.

The composition of the tears is, in 100 parts: Water, 99.06 to 98.70; solid matter, 0.94 to 1.30; epithelium, 0.14 to 0.32; albumen, 0.08 to 0.10; chlor. sod., phos. sod., earthy phos., mucus, 0.72 to 0.88.

Under ordinary conditions the lacrimal gland does not secrete tears; the conjunctivæ, cornea, etc., are kept moist by the normal secretion of the conjunctival and tarsal glands. The lacrimal is really (and is sometimes called) an *accessory* gland.

The secretion of tears as a product of the lacrimal gland is generally the result of a psychical or of a physical stimulus; the former is said to be a function of the optic thalamus. The new-born do not shed tears either because the cerebral tracts are not fully developed or because of the absence of adenoid tissue in the gland. The physical stimulus is derived from the excito-lacrimal fibers of the 7th nerve. The secretion of tears is lessened by hunger and is increased in a short time after food is given.

A knowledge of the *mechanics of lacrimal drainage* is of importance

to the ophthalmologist. In the first instance, the act of winking carries the tears from the general conjunctival surface of the eye towards the canaliculi, causing them to collect in the neighborhood of the puncta. In the second place, it is probable that the pull which the orbicularis muscle, in contracting, exerts upon the internal palpebral ligament through the intimate connection existing between the latter and the anterior wall of the lacrimal sac, is extended to the sac itself, and that the effect of this is to produce a sort of suction-pump action, which draws the tears through the puncta and the canaliculi into the sac. The tears pass through the duct by gravity, and their descent is facilitated by the elasticity of the lacrimal sac, which causes it, when distended by tears, to contract upon its contents.

Rutherford (*Brit. Med. Journ.*, June 13, 1913) points out that in the first stages of surgical anesthesia the internal canthi may be wet or dry; in the second stage the lacrimal glands are always active; in the third stage the lacrimal secretion ceases at the same time as the earliest reflexes disappear, and this cessation usually precedes the abolition of the corneal reflex by a very short interval. The time of the cessation of the lacrimal secretion during the induction period corresponds almost exactly with the time of reappearance during the recovery period. If one keeps just within the limits of suppression of the secretion, and when in doubt waits until the secretion again appears, one may feel confident that he is well on the safe side of deep surgical anesthesia, and away from an overdose.

The *absence of tears* and the evil consequences thereof are found in serophthalmus in consequence of occlusion of the excretory ducts of the gland; in paralysis of the trigeminus and in facial paralysis when the lesion is situated near the origin of the nerve; also in hysteria.

Epiphora is a passive condition, due to overflow of tears over the lower lid, in turn due to a variety of causes—to excessive secretion by the gland, to relaxation of the lower lid, and to ectropion or obstruction to the outflow of the tears.

Excessive *epiphora in infants* is due to delayed development of the lacrimal nasal duct, usually the nasal end.

Lacrimation, as opposed to epiphora, is an active process in which the excessive secretion of the tears is due to some irritative lesion in or about the eye. Nevertheless these two terms are frequently confounded. A. A. Bradburne (*Ophthalmology,* Vol. IX, No. 3, April, 1913) defines them as follows: Abnormality in the amount of tears present in the conjunctival sac may be the result of oversecretion, that is, lacrimation, or to an obstruction in the channels of outflow, that is, epiphora.

When the production of tears is excessive, it is the result of exaggeration of a reflex the nature of which must be sought in the extensive nervous anastomosis with which the lacrimal nerve has relationship.

When, however, the production of tears is normal in amount, its retention in the conjunctival sac must be due to interference with its outflow.

He adds that when the lacrimal canals are closed by swelling of the mucous membrane or by small plugs of epithelium or mucus, it may be necessary to gently wash out the ducts.

Epiphora unrelieved by such treatment may be the result of nasal deformities or disease, hypertrophic rhinitis, atrophic rhinitis, syphilitic and tubercular diseases being not uncommon causes.

LACRIMAL DISEASES.

Examination of the lacrimal apparatus. By *inspection* one learns the situation and size of the lacrimal gland, the degree of approximation of the lids to the ball, the amount of tears (whether excessive or not) and the patulousness of the puncta. By *palpation* one determines whether there is retention in the sac of an excess of tears, mucus or pus; by *probing,* the condition of the canaliculi and the duct; by *syringing* through a punctum one may detect an obstruction in any part of the tear passages thence to the nasal meatus.

By injection into the lacrimal passages of a mixture opaque to the X-rays (vaselin, vaselin and thoriumoxide, paraffin, and subnitrate of bismuth) the size and position of the sac, variations in the caliber of the nasal duct and the results of treatment may be accurately learned, as pointed out by Aubaret (*Rec. d'Ophtal. XXXII, p. 11, 1911*), von Szily and others. Moreover the exact position and relations of a dilated and diseased sac can readily be determined by injecting it full of paraffin, as described and pictured in this section.

Etiology of lacrimal disease. The causes are *local* and *constitutional.* Any obstruction to the free drainage of tears, such as nasal catarrh, to the secretion of tears, such as tumor of the gland, disease of the bones or other tissues of adjoining parts, and infection, are the principal local causes.

The underlying constitutional affections that most frequently produce diseases of the lacrimal organs and passages are *tuberculosis* and *syphilis.*

The nose and neighboring sinuses are involved in many cases of lacrimal disease, principally the maxillary sinus and ethmoid spaces. Infection easily spreads thence to the nasal opening of the nasal duct.

In *all* cases, therefore, of dacryocystitis or lacrimal stricture the condition of the nasal mucous membrane should be determined before operation on or other treatment of the sac or duct.

Phlegmonous inflammation of the sac may be due to pneumococci or streptococci of nasal origin. Dewatripont (*La Clinique Belge,* Oct. 28, 1911) gives an account of four such cases in all of which there had been a previous chronic dacryocystitis. In those cases in which a previous bacteriological examination had been made the only organism found as a cause of the chronic dacryocystitis was the pneumococcus, but when the phlegmonous inflammation set in that organism disappeared and was replaced by the streptococcus. In all the cases a purulent rhinitis in which streptococci existed was present, and as these organisms are not normally present in the conjunctiva the author concludes that they must have reached the lacrimal sac from the nose. The writer sums up the difference between these cases in adults and the tuberculous pericystitis met with in infants by stating that while the tuberculous infection is centripetal the streptococcic is centrifugal; that is to say, that the organisms that cause the former affection attack the sac from without inwards, whereas the reverse is the case with the streptococci.

Dewatripont points out the necessity for radical treatment of the underlying nasal affection.

Absence of the gland has been noted in cases of cryptophthalmia. See **Congenital anomalies of the eye**.

Dislocation or *prolapse of* the *lacrimal gland* is usually congenital, but it may be acquired. Under the upper eyelid and close to the outer canthus is readily seen a firm tumor, which when congenital is not productive of pain or deterioration of vision. It grows slowly but only in proportion to the growth of the eyeball. It may be returned to its proper fossa by pressure but upon relaxing the pressure the tumor reappears.

In the *acquired* form a small, movable tumor under the outer third of the upper lid is noticed. It appears spontaneously and disappears frequently, probably due to weakening of the supporting tissues from the absorption of orbital fat. When of *traumatic* origin the gland may prolapse through a wound in the upper lid. It may then be replaced and the wound sutured, or it may be necessary to excise the gland.

Atrophy of the lacrimal gland is usually associated with xerophthalmus, pemphigus or essential atrophy of the conjunctiva, trachoma, etc., and the changes are simple and affect all the tissues of the gland. See **Atrophy**, p. 666, Vol. I of this *Ecyclopedia.*

Hypertrophy of the lacrimal gland is often congenital and symmetrical. The outer third of the upper lid appears heavy and drooping. On palpation, a firm, slightly movable mass may be felt projecting beyond the margin of the orbit. When acquired, this condition may be due to syphilis, in which antisyphilitic remedies are indicated. If local and general therapy are unavailing, and the tumors are annoying and progressive, they should be extirpated.

Dacryolith. These chalky concretions in the gland are sometimes also called "calculi." They may cause irritation and should be removed through an incision made at the upper-outer cul-de-sac, through the conjunctiva. See, also, p. 3729, Vol. V of this *Encyclopedia.*

Lacrimal adenitis, or *dacryoadenitis.* Inflammatory changes in the gland (either acute or chronic), apart from general dyscrasiæ, are uncommon. See p. 3708, Vol. V of this *Encyclopedia.* An example of the acute infection is described by E. Jeffrey (*Med. Jour. Australia,* Aug. 7, 1915). A schoolboy, aged 7 years, complained of pain and swelling in his left eye. The symptoms had been present for a week.

On examination, the upper lid was seen to be in a state of ptosis and to be slightly cyanosed in its outer half. On palpation, a structure of moderately tense consistency, with well-defined edges extending down and covering the upper and outer quadrant of the cornea was felt. This swelling was slightly tender, but not extremely so. The mass was confined to the outer half of the upper lid, and seemed to be prolapsed from under the supra-orbital ridge, as no superior edge could be felt. The conjunctiva was somewhat injected, but in all other respects the eye was normal. The vision was not impaired when the lid was raised from the cornea. When the lid was everted, it was seen quite plainly that the ptosis was due to the mass pushing the upper lid downward in the region of the outer half of the superior fornix of the conjunctiva.

A provisional diagnosis of lacrimal adenitis was made. Next day he returned with pus beneath the upper lid; but a careful examination failed to reveal any evidence of suppuration. Treatment with fomentations and argyrol was instituted. The improvement was rapid. The mass, which proved to be an inflammatory process of the lacrimal gland, receded within a few days beneath the supra-orbital ridge, and was soon no longer palpable. There were no marked constitutional signs at any period of the affection, and no evidence of other glandular involvement was obtained.

Tuberculosis of the lacrimal gland generally shows itself as a chronic, slowly progressive tumor, associated with swelling of the parotid gland on the same side and usually with development of tuberculosis in other parts of the body. See **Tuberculosis of the eye.**

Dacryops, or *cyst of the lacrimal gland.* In addition to the matter on pp. 3694 and 3730, Vol. V of this *Encyclopedia,* it may be said that this distension of one of the ducts of the superior or inferior gland forms a swelling beneath the conjunctiva of the upper, outer fornix, more or less transparent, bluish in color and painless. It is lined with cylindrical epithelium similar to that of the duct and contains a clear or yellowish fluid resembling the lacrimal secretion. It may be as small as a pea or as large as a pigeon's egg.

Bride (*Ophthal. Rev.,* Vol. 33, p. 99) describes a marked case in a child of one year and five months. There protruded between the left upper lid and the globe at the outer side, a cystic swelling about the size and shape of a pigeon's egg. This mass was covered with conjunctiva, the vessels of which were dilated. It was fluctuant and translucent, and on eversion of the lid a white line was seen running horizontally along its upper surface. Under general anesthesia the cyst was removed entire. A severe muco-purulent conjunctivitis followed and it was found necessary to enucleate the eyeball.

Syphilis of the lacrimal gland. Involvement of the gland from lues generally occurs in the secondary and tertiary stages of the infection. The most common form is that of gumma, closely resembling gumma of the salivary glands. It consists of typical granulation tissue and cells in various stages of degeneration.

Igersheimer says that lues plays a very important rôle in affections of the lacrimal passages in children of 2 to 14 years. He reports 20 cases in which the nose was examined by a rhinologist, and in which the Wassermann reaction was positive. The affections consisted of dacryostenosis with epiphora, dacryocysto-blennorrhea, lacrimal fistula, dacryocystitis, and phlegmon of the lacrimal sac. Frequently other diseases were present, mostly specific chorioretinitis and parenchymatous keratitis. Fifty per cent. of these affections of the lacrimal passages in children were of luetic origin.

Chancre of the gland has also been observed.

Fistula of the lacrimal gland is a minute canal between the gland and the skin surface through which there is a continuous flow of tears. It may result from traumatism, operations on the lid or suppurative dacryoadenitis. See p. 5211, Vol. VII of this *Encyclopedia.*

Lymphomata. Mikulicz' disease is a chronic, indolent, symmetrical enlargement of one or more glands of the head. It is a non-inflammatory, non-painful type, not associated with systemic disease, beginning, as a rule, in the lacrimal and extending to the parotid and sub-maxillary glands. The etiological factors are, infection from

buccal or conjunctival bacteria, glandular irritation from some toxic agent in the blood or lymph stream; or it may be "idiopathic," as in leukemia or pseudo-leukemia. The *treatment* is by arsenic and thyroid extract. See **Mikulicz' disease.**

Trachoma of the lacrimal gland may be consecutive to trachoma of the conjunctiva. It leads to atrophy in conjunction with a similar process in the conjunctiva.

Amyloid degeneration of the lacrimal gland. The degenerated material fills the interstitial connective tissue spaces in these extremely rare cases. Hiwatari (*Nippon Gan Zasshi,* Sept., 1912) reports a case of this kind. In an otherwise healthy woman a tumor of the right lacrimal gland was observed; on extirpation it was found to be affected by a primary amyloid degeneration. See **Amyloid degeneration of the external eye**; as well as **Colloid bodies.**

Plasmoma of the lacrimal gland consists, as elsewhere, of a thickening of the adenoid layer due to infiltration with plasma cells and large masses of hyaline. It represents an early stage of hyaline and amyloid degeneration of the conjunctiva, an identical pathological process to that occurring in the lacrimal sac. The pathological picture varies according to the stage in which the growth is removed. In one case it was found to be composed almost entirely of plasma cells with little or no degeneration. In most cases this early stage is soon followed by the deposition of large quantities of hyaline or amyloid.

Its origin is a matter of speculation. It may be from the tissue cells or that the degeneration occurs in the vessel walls and in the intra-cellular tissue. The degeneration is usually secondary to plasmoma of the conjunctiva and cornea and often coexists with trachoma. The *prognosis* is not unfavorable. Excisions are often followed by recurrence so that a number of operations may be necessary.

For a complete account of this rare disease the reader is referred to an article by Verhoeff and Derby, (*Arch. of Ophthal.,* May, 1915).

Dacryoadenalgia. Neuralgia of the lacrimal gland is characterized by severe pain in the region of the gland, by photophobia, and by excessive lacrimation. It is said to occur especially in children, in pregnant women, and in the subjects of gout. It may assume a chronic character, and is prone to recur. It is probably a rare affection anywhere, and is certainly so in the United States. The local remedies which suggest themselves for its relief are atropine in the form of a collyrium, the application to the brow and over the region of the gland of oleate of morphine, or oleate of morphine and atropine, moist or dry heat, and the liberal use of a lotion of opium (ext. opii,

gr. x. to xv; aquæ, oz. iv.) or of belladonna (of similar strength). Quinine, iron, and other suitable constitutional remedies should also be administered. See, also, p. 3707, Vol. V, of this *Encyclopedia*.

Tumors of the lacrimal gland will be fully described under **Tumors of the eye,** as well as under such separate headings as **Sarcoma.** Here it may be said that of 132 cases of tumors of all sorts collected by Warthin he listed: hypertrophy 16; fibroma 4; fibroplastic 1; fibrolipoma 1; fibrochondroadenoma 1; fibroadenoma 1; myxoma 1; myxochondroma 2; myxoadenoma 2; chondroma 4; chondroadenoma 1; angioma 2; sarcoma 23; adenosarcoma 2; fibrosarcoma 1; cylindroma 1; colloid epithelioma 1; secondary cancer 1; myxoadenocarcinoma 1; enchondroma myxocarcinomatodes 2; cysts 4; chloroma 3; leukaemic tumor 1; lymphadenoma 2; lymphoma 3; lymphadenosarcoma 1; myxosarcoma 1; myxoadenosarcoma 1; adenoid 2; adenoma 13; adenoma with cancroid 1; cancroid 1; carcinoma 6; scirrhus 13; medullary cancer 2; encephaloid cancer 1; epithelioma 1; glandular cancer 1; symmetrical swelling (Mikulicz disease?) 1; fibroid hyperplasia 1; undiagnosed 5.

Excision of the lacrimal gland in toto. Ablation of the lacrimal gland. After complete local anesthesia, an incision beginning near the center of the upper orbital arch and following the bony margin is carried to a point 3 mm. below the outer canthus. Next the fascia or septum orbitale is cut through along its attachment to the orbital margin. Should fatty tissue present in the wound, it must be held to one side with retractors and all bleeding from the edges of the wound must be controlled before the gland is separated from its surroundings, inasmuch as it is sometimes difficult to distinguish the gland from the surrounding fatty tissue. By means of blunt-pointed scissors, fixation forceps, a small knife, and tenotomy hooks, the dissection of the gland can be accomplished and it may be removed without leaving any portion of it behind. Before the wound is closed all bleeding must be stopped. The lips of the wound are united with interrupted silk sutures, and the usual antiseptic dressing applied.

Excision of the palpebral portion. The upper lid is everted and drawn upward from the eyeball while the patient looks strongly downward. This exposes the palpebral gland, which may be seized with toothed forceps and drawn outward. Its conjunctival covering is next incised, and the gland dissected from its surroundings. Hemorrhage having been controlled, the wound may be closed with one or two interrupted silk or catgut sutures, the upper lid replaced, and a light pressure bandage applied. The stitches are removed on the third day.

Axenfeld (*Klin. Monatsb. f. Augenh.*, Vol. XLII, 1. p. 345) exposes the external canthus widely by means of two small blunt double hooks, bringing the upper surface of the palpebral gland into the field; after free injection of cocain-adrenalin or eusemin the overlying conjunctiva is divided and freed from the gland which later is then grasped with forceps and secured by a specially constructed Pèan. The gland is then abscised.

In this connection see **Lacrimal conjunctivitis.**

DISEASES AND ANOMALIES OF THE LACRIMAL CANALICULI.

A supernumerary canaliculus is not uncommon. It is found more frequently in the lower than in the upper lid. See **Congenital anomalies of the eye.**

Anomalies of the valvular folds in the canaliculi and duct. Aubaret states that the lower folds (valvulæ Hasneri) are frequently insufficient; their effect depends upon the character of the opening of the nasal duct. The middle and upper folds of the canal are unimportant. Rosenmüller's folds uniformly hold in the cadaver. He differentiates between physiological and pathological insufficiency; the former occurs occasionally from increased pressure within the nasal cavity during the act of sneezing and gives rise to no symptoms; the latter is uniformly accompanied by anatomical changes of the mucous membrane and occurs mostly in older subjects. This form may lead to dacryocystitis.

Congenital closure of one or both puncta is common. A supernumerary punctum may be present near the apex or base of the lacrimal papilla which may open into a canaliculus or may terminate in a blind extremity.

Absence of the puncta is generally a congenital condition due, as Parsons says, to non-canalization of the epithelial cord from which the canaliculi are formed.

Canalicular concretions. These are discussed on pp. 1372, 1374, Vol. II of this *Encyclopedia*, and under **Concretions, Ocular.** They are often masses of granular or fungoid outgrowths from the conjunctival surface. They sometimes lead to abscess in which the leptothrix, streptothrix or actinomyces are found. Wissman (*Klin. Monatsbl. f. Augenh.*, March, 1913) believes these deposits to be generally of streptothrix, and thinks that strains of streptothrix, cultivated from the lacrimal canaliculi, possess properties which in the greater majority are common to all strains and by which they can be distinguished from pathogenic streptothrixes found in other

places. He prefers the simple term *fungus concrements* to describe these deposits, as being most accurate. Streptothrix and actinomycosis must be sharply distinguished. Genuine actinomycosis of the lacrimal canaliculi is very rare and the general term actinomycosis of the canaliculi is not warranted.

The *treatment* consists in expression of the contents of the canaliculus and cleansing it with a solution of oxycyanide of mercury.

Tuberculosis of the lacrimal canaliculi is a very rare disease. Wittich (*Klin. Monatsbl. f. Augenh.*, May, 1913) comments on the fact that among the great variety of pathological conditions reported to have been discovered in the canaliculi, he has found no reference to tuberculosis of the canaliculi in association with tuberculosis of the sac. In the case which he publishes there had been a swelling in the sac region for six months. The conjunctiva was normal. The sac and part of the canaliculi were excised. The tuberculosis process which was found in the sac wall extended along the walls of the canaliculi. The epithelium was no longer squamous, but consisted of a number of layers of cylindrical cells, probably owing to destruction of the superficial squamous cells and proliferation of the deeper cells. He recommends surgeons, in removing a tuberculosis sac, to remove as much as possible of the canaliculi, in order to extirpate this possible seat of a recurrence.

Stricture of a canaliculus, when *acquired,* may be due to many causes—mostly infective. It is generally a part of stricture of the naso-lacrimal duct and infection of the sac. Conservation *treatment* is realized by dilatation (not slitting) of the obstructed canaliculus either in its course or at its opening into the sac, and by attention to concomitant diseases. In advanced age the obstruction of the canaliculus often begins with eversion, due to paresis of Horner's muscle; and in middle age to contraction of that muscle. In cases of catarrh of the sac the obstruction is often at the upper end of the duct and hence there is no necessity to pass probes all the way down the duct, or at least until the repeated use of antiseptic injections through the dilated canaliculus has been tried.

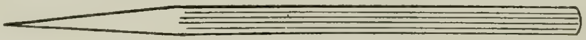
Canalicular syringing (as a part of irrigation of the lacrimal sac and duct); *foreign bodies in the canaliculi; polyp of the canals; wounds of the canalicular walls; mucocele of the canaliculi* and other headings pertaining to this part of the lacrimal apparatus are discussed on p. 1372 *et seq.*, Vol II, of this *Encyclopedia.*

Occlusion of the canaliculi as a temporary means of preventing infection of the conjunctiva (as a preliminary to cataract extraction, for example), may be accomplished by passing a suture through the lid

2 mm. below the margin, between the punctum and the caruncle. It is then brought out on the conjunctival surface and tied; or a galvanic cautery is applied for a moment to the punctum. To permanently close it the galvanic cautery is carried into the canal 5 mm. or more and allowed to remain until the canal is destroyed.

The former plan, devised by Frank Buller for the extraction of senile cataract or the performance of any major operation on the eyeball in the presence of an infected sac, is a most useful means of preventing microbic invasion of the globe.

In *probing the lower canaliculus,* the patient looks up and the lower lid is stretched toward the temple. The probe is passed horizontally through the straightened canal until its end meets the bony inner wall of the sac. Its handle is elevated in a line with the supraorbital notch (about 90 degrees) at which position the lower end will engage



Lacrimal Dilator.

in the mouth of the duct at the lower extremity of the sac and may be gently forced into the opening. The probe is advanced by gently graduated pressure until its finger plate is on a level with the lower margin of the brow.

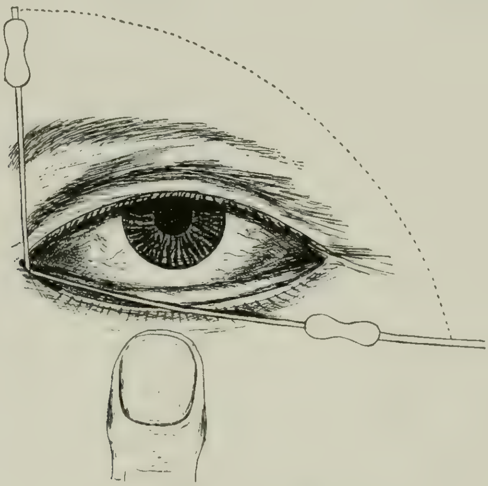
In *probing the upper canaliculus,* the upper lid is put upon the stretch, the end of the probe inserted vertically into the upper punctum and thrust horizontally through the canaliculus to the bone and the dilatation of the duct accomplished as above. See, also, p. 1374, Vol. II, of this *Encyclopedia.*

Slitting the canaliculi. This minor operation was in 1851 proposed by Wm. Bowman, as a preparatory step to probing the nasal duct. The end sought was to treat the stricture from its natural aperture. When permitted to choose, operators usually prefer, as a matter of convenience, to operate on the lower canaliculus.

The patient, seated in a chair facing a good light, is told to direct his eyes upward and the operator, standing behind, supports the patient's covered head against his chest. With the first and second fingers of the non-operating hand, the lower lid is drawn gently outward to facilitate the insertion of the point of the knife through the punctum and into the vertical part of the canal. If there is difficulty in accomplishing this the punctum may be enlarged by a dilator. (See figure.)

The lid is now with increased traction drawn horizontally toward the temporal side, thus straightening the canal and obliterating the

minute circular elevations and depressions of its mucous lining. The instrument is next tilted a little below the horizontal line, its point still retained in the opening of the canal. (At this juncture, carelessness or undue haste will almost certainly cause the instrument to be dislodged.) By a twisting movement, the knife is now with gentle pres-



Introducing a Lacrimal Probe.

sure forced horizontally through the canal toward the nose, and continued until its point is felt in contact with the nasal bone. By slight to-and-fro movements, the hard surface of the bone may easily be distinguished, or entanglement of the end of the instrument in a fold of mucous membrane determined, by the sensations of touch imparted to the surgeon's hand. If the point be properly inserted, and is not too large, these to-and-fro movements cause no dragging or pulling of the skin at the inner canthus. The instillation of a few drops of a cocain and adrenalin solution greatly facilitates progress by preventing pain and contracting the vessels of the mucous membrane.

Various canaliculus knives are pictured on p. 1376, Vol. II, of this *Encyclopedia*. In addition to these other instruments have been devised for the same purpose. One of these is by Greenslade, which consists of a fine director, in the groove of which is a sliding knife manipulated by the action of the thumb upon a small button in the handle of the instrument. It is also used for widening the lacrimal canal.

Hoffmann (*Trans. Tenth International Oph. Congress*, 1904) proposes a method, particularly applicable, he claims, to inversion and

eversion of the lower lid, closure or diminution in caliber of the punctum, acquired displacement, paralysis of the seventh nerve, and as a preliminary to enucleation. He washes out the canaliculus with the Anel lacrimal syringe, and introduces a small Weber knife, as in the Bowman operation. In eversion of the lid, the cutting edge is directed toward the ball; in inversion, toward the operator. The incision is made as far as seems desirable, half way to the caruncle, or into the sac itself. The end of the cut marks the site for the removal of a triangular piece of membrane, which forms a new opening into the canal for the escape of tears. At this point the posterior lip of the cut and posterior wall of the canal are grasped by forceps, while the lower lid is drawn down and away from the ball. The first cut, made with the scissors at right angles to the slit and to the outside close to the forceps, is carried the depth required to establish the new opening. The second cut embraces a part of the mucous membrane held by the forceps, varying in size from the head of a pin to that of a small pea or bean. The lid is now allowed to return to its original position, completely hiding the denuded portion.

This device will occasionally be found sufficient to relieve the epiphora when due (as it rarely is) to blocking of the canal from a collection of microliths, or broken down epithelium. The canaliculus knife (Weber's preferably) is introduced as already described, except that the twisting movement of the blade must be limited to less than a quarter turn. Its cutting edge is directed upward and slightly toward the ball, thus forming a gutter for the reception and discharge of lacrimal secretions. When the point touches the bone at the inner extremity of the canal and is not, by gentle retraction and advance, caught by a stricture, or fold of the mucous lining of the canal, it is safe to assume that the canal is properly established.

W. H. Snyder (*Ophthalm. Record,* June, 1904, p. 256) operates for badly placed eversion of the lids by freshening the edges of the slit canaliculi and suturing them. The canals are obliterated in a few days. A new passage (which should be kept open with a probe for a couple of weeks) is then made obliquely from the conjunctiva to the lacrimal sac, so directed that its lips are as nearly as possible in contact with the globe. So placed it drains remarkably well. He elevates the handle of the canaliculus knife, firmly holding the lid, and divides the upper inner wall of the canaliculus from the punctum to within 2 millimeters of its opening into the sac. This is accomplished when the handle reaches the supraorbital notch. In many cases, it is not necessary to cut the canaliculus more than 1½ millimeters, thus confining the incision largely to the punctum, the

blunt point of the blade reaching the nasal bone without further cutting or elevation of the handle. Care should be taken not to wound the lid, an accident that may readily happen to persons with prominent eyes. The upper lid is easily drawn out of the way by a finger of the right hand. As a precaution against making a false passage, a conical sound, or the dilator of Galezowski, may be introduced and the canaliculus well stretched for a few minutes preceding the introduction of Weber's knife. Withdrawal of the knife is attended by moderate, temporary pain and slight hemorrhage. If the incision be not carried beyond the caruncle, it forms a perfect gutter for the passage of tears, and, opening slightly inward to the globe, presents no deformity.

Lacrimal probe. This instrument is a solid metal rod, usually silver, varying in diameter from ½ mm. to several mm., slightly curved and of sufficient length to permit of being passed through one of the punctal openings and along the corresponding canaliculus into the sac and duct to the floor of the nose; but the passage may be confined to any part of the canal. The best known examples are described and pictured on pp. 1374-1376, Vol. II, of this *Encyclopedia.*

Insertion of a lacrimal or divulsion probe. Effectively to pass a probe into and through the duct, in the presence of disease or stricture, slitting of the canaliculus is, with rare exceptions, a preliminary necessity. In a subject with a large punctum, an easily distensible canaliculus, or a lid large enough to allow of considerable retraction, it may be avoided. Such cases, however, are rare.

The experience of Ziegler, who forcibly dilates both canaliculus and duct, generally under local anesthesia, for the cure of nasal duct obstruction, is worthy of consideration. He uses a large-sized, pointed probe and generally finds one, or, at most two, divulsions or probings sufficient.

The patient is directed to raise the eyes, and the lower lid is then stretched towards the temple, which removes, as elsewhere stated, all folds in the mucous lining of the canal. The probe is now passed horizontally into the sac. Upon touching the inner wall with the point of the probe, its handle is elevated to a point opposite the supraorbital notch, an angle of about ninety degrees, at which position the lower end of the instrument will, in the majority of instances, be directed to the furrow between the cheek and the nose. The lid is then released and allowed to return to its natural position. The probe should as nearly as possible be curved in correspondence with the direction of the canal. Prominent eyebrows must be stretched upward, out of the way of the probe. With its finger-plate directed forward,

the lower end of the probe is gently forced into the opening of the duct. Should the lid be dragged by the movements of the probe, it is evident that its end has been caught in a fold of the mucous membrane, and is not properly engaged in the duct. The handle is purposely held loosely, so that the direction of the point may be instantly changed to free it from entanglements, or to alter its direction. When the point is once properly engaged in the duct, the probe remains in position without support. The upper terminus of the duct, it should be borne in mind, is its narrowest portion, and indicates the usual location of the stricture. The probe is advanced by gently graduated pressure until its finger-plate is on a level with the lower margin of the brow, its lower end touching the sensitive floor of the nostril, where its further progress is checked. The stricture may, of course, be found in any part of the duct, and when the operator encounters an obstruction, caution and gentleness must be exercised to avoid the creation of a false passage through the mucous lining (an accident likely to happen to a careless or inexperienced surgeon). The probe, in this event, is slightly withdrawn, its proper direction again determined and the advance continued. There is less danger of making a false passage when a large or moderate-sized probe is used. Bowman's number 4, 5 or 6, for instance, is less likely to become entangled in folds of the mucous membrane than a number 2.

After insertion, the probe is allowed to remain in position fifteen minutes. It is then slowly and cautiously withdrawn. The operation should be repeated every day, or every second day, gradually increasing the size of the probe, until the duct remains well opened. The intervals of insertion may then be lengthened by a week or two, but should not be wholly discontinued until the duct is permanently established.

Self-probing of the lacrimo-nasal duct. As Benson (Wood's *System of Oph. Operations,* Vol. II, p. 1587) and Wood and Woodruff (*Commoner Diseases of the Eye,* 3d ed., p. 355) have pointed out, while the patient not uncommonly gets great relief from the operation and the subsequent probings done by the surgeon he often objects to the discomforts, loss of time, inconvenience and pain of the post-operative procedure and abandons the treatment. In that event the stricture again slowly closes, purulent collections once more stagnate and collect in the obstructed duct and sac, and the last state of the patient is worse than the first. To avoid this unhappy conclusion one may teach the patient to introduce his own probes.

As soon as the soreness following the slitting of the canaliculus and the nasal stricturotomy has passed the surgeon places the patient

before a small mirror and instructs him in the method just described. As a rule the invalid declares that it will be impossible to learn and practice the various steps of the procedure, but in the great majority of instances a few lessons suffice. Although the process is awkward for the first few sittings, the difficulties are soon overcome. Then, the patient, having his own probes, cocain, etc., at home, makes daily, bi-weekly or tri-weekly introductions, and is independent of the surgeon and is not affected by the dozen or more influences that might keep him away from the oculist's office or dispensary.

Even the irregular introduction of probes is fatal to a cure of nasal duct stenosis because the crux of the plan is the regular, continuous, uninterrupted opening of the duct for many weeks or months.

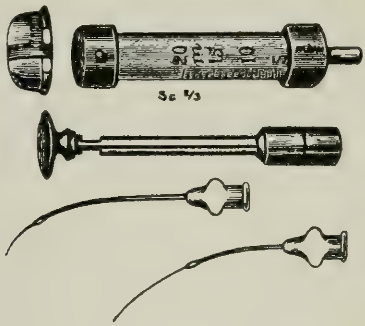
Carried out in this way (with an occasional visit to the surgeon), the plan of treatment is rational and successful and may be persevered in for a year or more or until the stricture is permanently open.

Armaignac is a conservative in the treatment of the lacrimal passages; in a period of over thirty years he has never slit the canaliculus or the punctum and has uniformly succeeded in the space of a few weeks in passing quite large probes and curing epiphora and dacryocystitis, and fistula of many years' duration. He is a convinced adherent of the treatment by probing; he has devised a series of ten sounds in place of the six of Bowman; these sounds are somewhat olive-shaped. This form renders probing less painful than with cylindrical probes, and allows a more satisfactory determination of the seat and extent of the stricture. Instead of dipping the probe in oil, he injects two or three drops of olive oil into the sac.

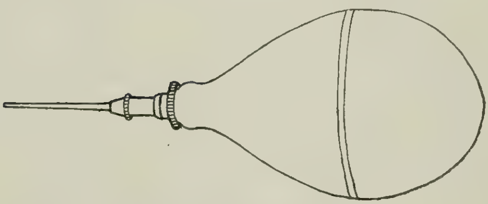
Lacrimal syringe. This instrument is a glass or metal cylinder fitted at its distal extremity with a short, curved canula adapted to the size and shape of the nasal duct. Its capacity is about twice that of the usual hypodermic syringe and its purpose is to cleanse and render sterile the lacrimal sac and the nasal duct. Anel's model is that commonly employed. Harman (*Oph. Rev.*, Dec., 1908) believes that the success of the syringe depends on the relation of the piston and the cylinder. In his instrument (see the figure) these fit quite loosely, so loosely that when the syringe is hung vertically by holding the handle of the piston rod the barrel descends by its own weight! And yet so perfect is the action of the syringe that it will suck up water through the fine nozzle, and that without admitting air into the barrel; or conversely, the water can be ejected for some ten feet by a very little pressure of the piston, without leakage from the joints or regurgitation. This sounds rather a bold statement, but it is quite true. The perfection of the compression of the syringe depends upon

the narrow circular groove in the solid metal plunger. The groove holds a cushion of air, which makes a perfect packing, and prevents regurgitation, but allows of perfect freedom of motion by the piston. (Some of the syringes sent out have a wire ring set in this groove to prevent the piston working too easily, but for ophthalmic purposes it is best to remove the wire.)

The barrel of the syringe is of glass, and the mounts are secured to it by a metal packing, which allows of boiling without fear of loosening them.



Harman's Lacrimal Syringe.



Simple Lacrimal Syringe.

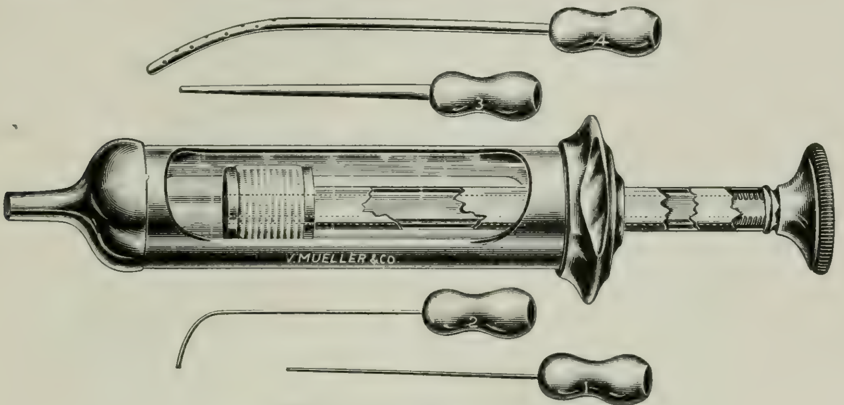
There are two nozzles: one long and slender, the other short and stout. The mounts have winged butts which greatly facilitate the fixing and detachment of the nozzles.

The collar which holds in the piston has a bayonet lock, and the projecting rim of the collar is wide enough to give a good grip to the fingers. This rim has two "flats" on it so that the syringe cannot roll off the table.

To secure the best results the syringe should be washed after use by drawing water, and then alcohol, through it; then the piston should be detached and placed in the separate clips fixed in the case for its reception.

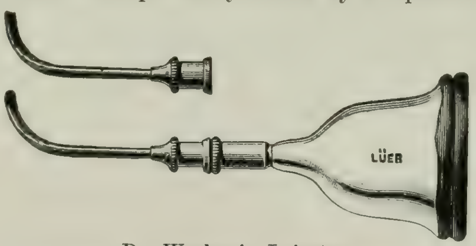
Wilder's lacrimal syringe has a glass barrel partially encased in a metal jacket. The piston is made of wrapped asbestos string, and

expands by turning the piston rod upon a milled screw. It can be boiled and the piston is easily replaced when worn out.

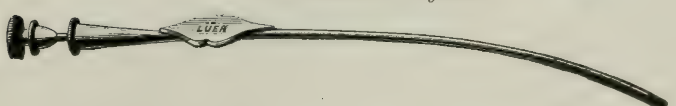


Wilder's Lacrimal Syringe.

The sac, if distended, is emptied by pressure. The hollow probe, carrying the syringe, is passed into the sac and a little fluid is injected. No attempt is made to overcome obstruction by forcible injection of fluid, for this may do mischief. Time is allowed for the fluid to act. Moderate pressure will then generally cause the probe to enter the bony duct. Sometimes it is tightly gripped in a contracted channel, sometimes a definite obstacle can be felt to give way. A little more fluid is injected, and this is probably tasted by the patient in the throat.



De Wecker's Injector.

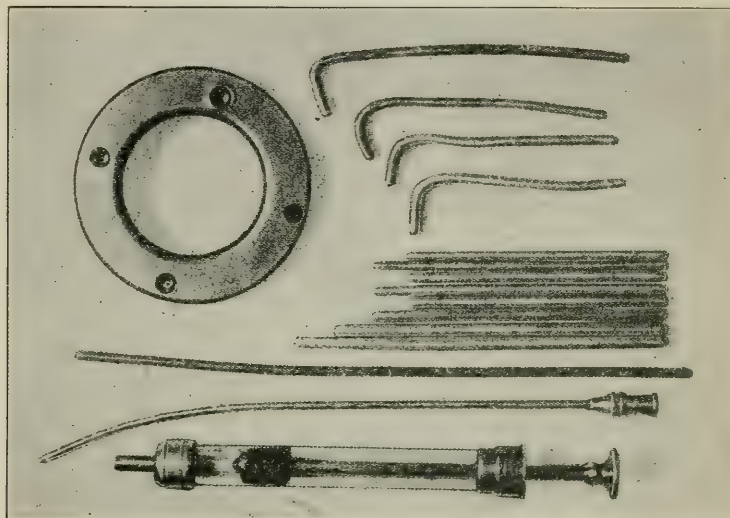


De Wecker's Guarded Lacrimal Sound.

The probe is pushed down till the floor of the nose is reached, then partly withdrawn, another drop or two being injected meanwhile so that the whole of the channel may be anesthetized. The syringe is removed and filled with weak izal solution or other innocuous fluid and the sac washed out therewith.

Lacrimal canula. This is a tube of aluminum, silver or gold which when inserted into the lacrimal canal separates its walls and allows the tears to pass through its interior into the inferior meatus of the nose. Like the style its purpose is to preserve the lumen of the canal and obviate the necessity for frequent probing. It may remain in place indefinitely or until the patulousness of the canal is made permanent. The canula should be removed occasionally for cleansing.

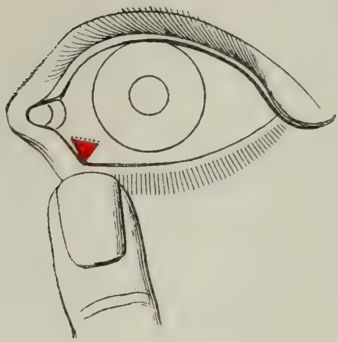
Lacrimal style. Styles made of lead, silver or gold are curved to fit the lacrimal canal and are to be worn for weeks or months to preserve the calibre of the canal. A style should be about 2 mm. in



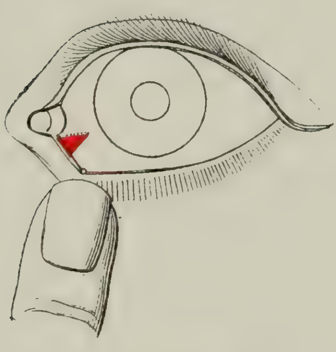
Lacrimal Styles. Actual size. (Priestley Smith.)

diameter, smooth, round and long enough to permit the rounded end to rest on the floor of the inferior meatus. It should have a shoulder to prevent slipping which fits into the slit inferior canaliculus. Gold is the most desirable metal for it does not corrode and is less liable to be covered with deposits. Its purpose is two-fold: to preserve the patulousness of the canal as above stated, and to permit the lacrimal secretion to pass along its sides to the inferior meatus.

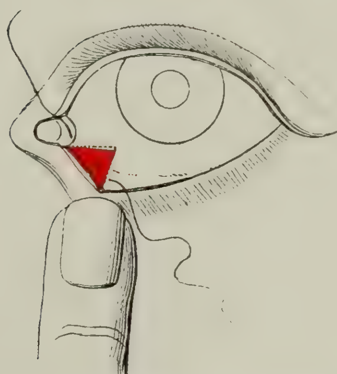
By their use, frequent probing, a painful and often ineffective treatment, is avoided. The style should be the size of a number eight probe, curved to fit the canal and its upper extremity bent horizontally. The leaden style is pliable, adaptable, impervious to the secretions and easily obtained. It should be slightly smaller than the probe last introduced, bent at an acute angle at its upper extremity as the hollow



A. First Step.



B. Second Step.



C. Third Step.

Hoffmann's Improvements on Bowman's Operation
of Slitting the Canaliculus.

style, to prevent it from dropping into the duct and to provide a handle by which it may be readily removed.

Other materials recommended are coarse silk thread, horse hair, silk worm gut, fine wire, cat-gut and threads stiffened with gum.

Priestley Smith (*Ophthalmic Review*, Sept., 1911) recommends pure silver wire, well annealed, i. e., softened by heat after it is drawn. They are of three thicknesses, approximately 1.3, 1.5, and 1.7 mm. The thickest are seldom wanted. In each thickness they are of four lengths, 35, 40, 45 and 50 mm. The longest are needed only when it is necessary, for a short time, to let the crook lie outside the lower lid instead of in the canaliculus. The ends are smoothly rounded. They are kept ready for use in glass tubes and so kept do not become tarnished. They are bent to the necessary shape at the time of using by means of the bending-ring seen in the photograph.

The *insertion of a style* is an operation requiring deliberate and delicate manipulation. Anesthesia and detergescence obtained as far as possible by injecting into the tear passage small quantities of a 2 per cent. solution of cocain to which a little adrenalin has been added—about 2 drops of adrenalin to 20 drops of the cocain solution. The injection is made with a small hypodermic syringe to which is fitted a hollow probe curved like an ordinary lacrimal probe and about 1.25 mm. in thickness. (See figure.)

The punctum is enlarged, if necessary, with Nettleship's dilator. The lower canaliculus is slit with the canaliculus knife in such fashion that the gutter shall look backwards rather than upwards when the lid resumes its normal position.

A lead probe, smooth and dipped in vaselin, is passed down the whole length of the passage, withdrawn a very little, bent outwards at the canthus over a strabismus hook, and with the help of the same hook gently removed. It supplies a model for the length of the style.

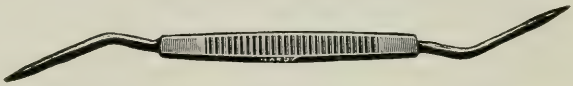
A suitable style is bent to the required shape, dipped in vaselin, passed into the sac and pushed down into place. The crook should occupy the whole length of the canaliculus and lie hidden in it. It must not tend to turn backwards toward the eye. It must not touch the cornea when the eye turns toward the nose. It must be withdrawn and altered a time or two if necessary until it fits properly. It is withdrawn by means of a small forceps or hook. So long as watering and discharge continue it should be removed occasionally, cleaned, and reinserted, or replaced by a thicker one.

Too long wearing of a style may keep up a slight discharge which ceases when it is removed. In a few instances the style has disap-

peared into the sac and it was necessary to enlarge the opening into the sac for its removal. This can only happen when the sac is large and the shoulder too short.

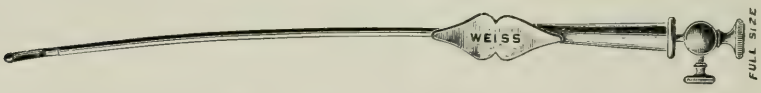
Wessely (*Wien. Klin. Rundschau,* May 11, 1913) advises that a style be left in the lacrimal canal for 24 hours and a few drops of tincture of iodine injected by means of a syringe with a platinum canula. In 24 out of 32 cases the discharge stopped after the first injection.

Lacrimal bougies, consisting of cocoa-butter or gelatin in combination with an antiseptic and astringent, have been used by some surgeons. See p. 1254, Vol. II, of this *Encyclopedia.*



Ziegler's Lacrimal Dilator with Double End.
For use in excision of the lacrimal sac.

Nettleship's Lacrimal Dilators. With Long and Short Tapers.



Desmarres' Cauterizing Instrument for the Lacrimal Duct.

von Hoffmann's Lacrimal Knife.

Hollow Lacrimal Style and Director of Bickerton.

Dacryocystitis. The various forms of infection and inflammation (both acute and chronic) of the lacrimal sac tissues, their pathology and treatment have been discussed on p. 3709, Vol. V, of this *Encyclopedia, et seq.,* to which the reader is referred.

Although surgical interference, especially in the chronic forms of sac infection are often needed for a cure yet it must be borne in mind that milder means sometimes suffice. See, for example, under **Fluorol.**

Ethylhydrocuprein, also, particularly in *pneumococcic dacryocystitis,* is frequently curative. In the presence of other bacteria its value is less evident.

The *operative measures* more recently adopted for the relief of this condition not here considered will be taken up later on in this section.

Orbital phlegmon as a result of sac infection must not be forgotten. F. Rossler (*Klin. Monatsbl. f. Augenheilk.*, 53, p. 383, 1915) describes the right eye of a woman, aged 48, who had suffered for 30 years from epiphora and for a year from purulent dacryocystitis. The eye became suddenly swollen and painful, and was blind on the second day. The writer found intense swelling of the lids and the region of the lacrimal sac. The eye was much injected, immovable; exophthalmos, iridoplegia. The vitreous showed fine opacities, the retina was whitish-opaque; disc ill-defined; veins very ectatic; arteries tortuous and narrow. No hemorrhages and no red spot at the macula. V.=0. Several incisions emptied a large quantity of pus. After five months the disc was white, the opacity of the retina diminished, veins of almost normal width, arteries very narrow, the lower temporal third of the optic disc covered with fine, granular, greyish-black pigment, interspaced by white stripes. The tear-sac was extirpated. As the lacrimal fossa was lacking, the conditions were favorable, through an enlargement of the sac toward the orbit, for a propagation of the suppuration into the orbit. The sudden blindness and the ophthalmoscopic changes made it probable that it was caused by a violent compression of the optic nerve and its vessels and propagation of the inflammation through thrombo-phlebitis. Not only the vein but the central artery also was obstructed. Rossler assumes that as part of the damage to the optic nerve (in consequence of the inflammation) small hemorrhages occurred either by diapedesis or by rupture of the vessels, and that the blood was not absorbed owing to defective circulation, but deposited as pigment.

The Editor has seen a similar case, in which the erysipelatous (streptococcic) invasion had, among other severe consequences, produced necrotic periosteal areas on the frontal bone and the bony walls of the orbit.

Optic nerve atrophy as a sequence of abscess of the lacrimal sac without orbital cellulitis, purulent disease of the ethmoid or sphenoid cells, has been reported, also, by Boyd (*Trans. Oph. Soc. Colorado,* Feb. 20, 1915).

TREATMENT OF CHRONIC DISEASES OF THE SAC IN GENERAL.

In addition to the remarks under **Dacryocystitis** we agree in general with the dicta of Kuhnt (*Zeitschr. f. Augenheilk.*, Nov., 1913; see, also, *Ophthalmoscope*, p. 681, Nov. 14, 1914). He believes that

the main reason why the treatment of lacrimal disease is so unsatisfactory is because we have regarded it as a primary affection, whereas it is so often a secondary condition. It follows that simple probing alone must be useless; in fact, it is generally harmful. He adds that secondary disease of the lacrimal duct is possible (1) from general disease of the body; (2) from the conjunctival sac; (3) from the nose; (4) from the surrounding tissues, especially the periosteum and bone in the lacrimal groove and surrounding the duct.

General diseases which affect the lacrimal passages are tuberculosis, syphilis, and many acute and chronic septic diseases.

The conjunctivæ, if the mucous membrane of the lacrimal passages be healthy, have only a slight and exceptional influence. It is astonishing how rarely the sac becomes infected in acute blennorrhea and diphtheria. One can almost surmise that the secretion from the mucous membrane of the sac inhibits the development of organisms, and that their toxic action causes swelling of the canaliculi and mechanically excludes the micro-organisms.

Diseases of the nose have, on the contrary, great influence upon the etiology of lacrimal affections. We must differentiate between disease of the nasal mucous membrane, including deformities of the inferior meatus and the inferior turbinal, and diseases of the anterior nasal sinuses.

Recurrent coryza, hypertrophic rhinitis, and alterations in the size and position of the inferior turbinal, are causes of lacrimal disease; but sinusitis, especially the chronic type, is far more important. Brunzlow, working in the Bonn clinic, found definite sinus disease in 63.5 per cent. of all the cases he examined, in 11.3 per cent. there was a suspicion of sinusitis, and only in 3 per cent. was the nose normal. The antrum of Highmore and the ethmoid cells were most frequently affected. Treatment must not be of a routine nature, but must be intelligently adapted to each individual case. The nose must be carefully examined by an expert rhinologist with the help of good skiagrams. The condition found in many extirpated sacs shows that it is impossible to hope that conservative methods will cure all cases; many of them can only be permanently relieved by removal of the sac, but in a certain proportion of the cases nasal treatment, followed by lavage, will be successful. Probing with metal sounds is absolutely contraindicated in all cases; such a procedure causes erosions of the mucous membrane, and only aggravates the condition. If lavage fails, it is permissible to use a thin, fish-bone probe, well lubricated. If adhesions be present, Kuhnt slits up the canaliculus even into the sac, and he then uses the fish-bone probe daily. The introduction of a silk thread,

as recommended by Stahl, may prove very useful, and can do no harm. If these means fail, we must either excise the sac or try to form a fresh passage between the sac and the nose, using the procedures of Toti, West, Polyák, or van Eicken. Kuhnt thinks that all these operations are still "on trial," but he has obtained good results from Toti's operation.

Excision of the sac is indicated in tuberculous and lupoid dacryocystitis and in the presence of ozena; in cases of advanced changes in the mucous membrane, such as polypoid degeneration; when the sac is very much shrunken, as in advanced trachoma; in all cases when the surrounding bone is diseased; and when an operation is to be performed upon the globe. Polyák's and West's operations may be undertaken when there are tight strictures but the passages are reasonably normal; van Eicken's operation is suitable to cases when the antrum is diseased; Toti's method is useful in all other cases of obstinate dacryocystitis, when at least one canaliculus and punctum are normal.

Measures for the relief of lacrimal duct obstruction.

As has been frequently noted before, the naso-lacrimal canal may be obstructed in any part of its course. The most frequent sites are at the junction of the lower end of the sac and the commencement of the duct and at the terminus of the duct in the inferior meatus. The *etiology* of this condition is varied. It is often secondary to general disease of the body, to tuberculosis, syphilis, and many acute and chronic septic diseases. Closure can rarely be laid to infection from the conjunctival sac. On the other hand it is common in diseases of the nose—the ethmoid and sphenoid (frequently).

Bronszlow (*Zeit. f. Augenh.*, Mar., 1913) found it in forty-five cases: parasinusitis (3): sinusitis of frontal and maxillary cavities and ethmoid cells (3): ethmoiditis and antrum disease (18): ethmoiditis (18). In only 3 per cent was the nose and its cavities normal. *Immediate causes* are swelling of the lining membrane from inflammation which has extended from the nostril: hypertrophy or cicatricial contraction of the mucous membrane: anomalous development of the nasal bones: strictures after nasal ulcer: caries of the nasal bones: the exanthemata: periostites: gumma or other tumors: traumatism: foreign bodies in the lower lacrimal canal and in the nasal chambers: actinomycosis of this region: membranous obstruction of the outlet at the nose. See, also, **Dacryocystitis.**

When the simpler measures already mentioned—local disinfection,

probing, syringing, treatment of the nose, etc.—have failed to cure the disease operative procedures are demanded.

Drilling through the bony obstruction in the nasal duct. The old method of perforating the bone and fitting a probe or style into the canal to retain its caliber, in vogue until the second half of the eighteenth century, has been recently modified by L. E. Schoch (Wood's *System of Oph. Operations,* Vol. II, p. 1593) as follows:

"I slit the canaliculus, and entered a small drill into the canal as far as the nasal wall, then raised the drill in the same manner as in passing a probe, and milled it between my thumb and finger, holding the drill on a line that would bring the point into the nostril. This line angled at about 75°. With a little pressure and milling, I soon made a passage into the nose almost at the opening of the original tube. After making sure that I had pierced the bone and reached the nostril, I examined the latter and found the point of the drill resting on the nasal floor. I removed the drill, inserted a Bowman probe and let this probe remain for a few days, instructing the patient to move it up and down slightly, and also to rotate it by gentle twisting. In this way, after two weeks, the new canal around the probe became healed. The probe was then removed, to be replaced at intervals of a few days. Afterwards, I inserted a silver tube, and had the patient wear it for some months, using ordinary eye washes, and occasionally syringing the canal. Some years ago I had a letter from this patient, stating that the new canal had remained patulous, and had never given any trouble. This was about fifteen years ago, and, up to the present writing, I have not heard that the opening has closed. The instrument I used was a steel wire cotton applicator, seven inches long including the handle, the size of a number 4 Bowman lacrimal probe, filed flat on three sides three-fourths of an inch from the point."

The use of styles, solid and flexible, in nasal duct obstruction. It occurs in exceptional cases that repeated probing is impracticable. In this event, excessive lacrimation may be relieved, and the canal held open by the introduction of a style. Permanent recovery from stricture is less assured by this method of treatment than by incision and probing, or probing without incision, and authority for its use hinges on the patient's inability to consult the surgeon at necessary intervals, or refusal to submit to repeated probings. But, as probing is always more or less painful, the surgeon not invariably skillful, or the patient able or willing to continue treatment under his personal supervision, or cannot be taught to introduce his own probes, the wearing of a style may, under these varying conditions, possess distinct advantages.

Theobald (*Reference Handbook of the Med. Sciences,* p. 397) asserts that more than a hundred years ago, 1781, the plan of introducing a hollow tube of gold or silver into the nasal duct was proposed by Wathen, of England. Ware suggested the temporary use of nail-headed styles, introduced by incision into the lacrimal sac.

Beer employed catgut cords of different sizes, a fresh part of the cord being pulled into the tube each day. Mejan used, instead, meshes of silk threads.

Blizzard filled the sac with quicksilver, expecting the obstruction of the duct to yield to the force of gravity imposed by its weight. His reasoning was sound, and the method might profitably be employed in exceptional cases. Burton Cooper (*Ophthalm. Review,* Jan., 1907) suggests silk-worm gut.

John Green urged, some years ago, the employment of leaden styles. The advantages, he claimed, are that the leaden style is easily introduced and yields, without undue pressure on the parts, to facial peculiarities.

The consensus of enlightened opinion remains strongly affirmative of the conviction that treatment by knife or probe, under the direct care of the surgeon, affords the surest means of relief. No method of treatment thus far discovered relieves the medical attendant from close personal supervision and responsibility in these cases. For it should not be forgotten that patients as a rule are uninstructed, and that it is not possible, in the available limits of the surgeon's time, to impart to his subject precisely the size of the style to be employed, how it should be introduced or the length of time it should be worn. These are questions for the surgeon, and not the patient, to determine, and upon their intelligent solution, the success of treatment largely depends.

Moulton (*Trans. Sec. Oph. Am. Med. Assoc.,* 1908, p. 323) has called attention anew to the value of the leaden style as a means of causing, by pressure, absorption of the hypertrophied tissue. He prefers lead because it is pliable, adaptable, impervious to the secretions, and easily obtained. (Ziegler, on the contrary, claims that lead is too soft, and to remedy this defect, adds an alloy of tin). Moulton's style is slightly smaller than the probe last introduced, thus enabling the patient to wear it with comfort, and still have slight pressure exerted on the walls of the canal in the intervals of the use of probes. He says three sizes of leaden wire may be obtained, 1, 1½ and 2 millimeters in diameter, respectively. One end of the style is bent at an acute angle, and projects from the canaliculus in order to prevent the wire from dropping into the duct, and also to provide a handle by which it may readily be removed.

In an obstinate case of dacryocystitis in a child, J. C. Berry (*Bost. Med. and Surg. Jour.,* April 29, 1909) successfully employed a seton. We quote his experience: "The child was five years of age, and had profuse purulent discharge from both lacrimal sacs from a week after its birth. He had received faithful treatment at different times from two competent oculists who evidently believe in the use of the lacrimal probe; for, as I examined the enlarged canaliculi, I found them so dilated as to receive a number 8 probe, which literally fell to the bottom of the canal. When inserting a probe for the first time, it is my habit to throw a strong light into the nostril, well dilated, and see if I can discern the tip of the probe (frequently possible in adults), or, if not visible, then to seek to touch it with a nasal probe. In this case, I could do neither. Forcing the lacrimal probe well downward and forward, I finally succeeded in bringing its tip within my field of vision, when I found it to be covered by a tough membrane, the lacrimal sac thus being impervious; while in the opposite nostril, the anterior end of the lower turbinal was firmly adherent to the wall, thus concealing everything in this nostril and rendering necessary the removal of the anterior portion of the lower turbinal. This was done at once, and brought plainly into view a similar membrane covering the lower end of this canal. With a pair of Hartman's cutting-edge forceps, I seized and took away that portion of this membrane covering the end of the lacrimal probe, and then pushed the probe on into the nasal cavity. In the case of the left duct, this was at once successful, little further treatment being required, save the daily cleaning of the duct and nasal cavity, and the injection into the canal of a two per cent. solution of ichthargan. With the opposite nostril, however, more trouble was experienced, the membranous obstruction reforming at the nasal end of the canal even after being twice removed. To insert a style that should reach quite through to the floor of the nostril, thus including the lower portion of the canal, seemed inadvisable, because of the inflammation it would occasion by pressure on the floor itself, and I, therefore, resorted to the use of a seton. With the child under ether, I passed a small, flexible probe, olive-tipped at one end, and with an eyelet armed with several threads of sterile floss silk at the other, on through the canal. With a pair of alligator nasal forceps and good illumination, it was easy to seize this probe as it appeared in the nostril, bend it sharply upon itself, and thus work it downward gradually through the canal and out through the nostril. * * * The projecting ends of the silk were brought together and tied, and the whole held safely along the side of the nose by surgeon's plaster. The seton was cleaned with boric acid solution, impregnated with a 2 per

cent. solution of ichthargan, and moved every day. At the end of the week * * * the seton was removed. The discharge soon ceased under a simple boric acid cleansing and application of ichthargan, and the child has remained well ever since."

The case illustrates: (1) The necessity of intranasal work in some of these cases of obstructive blennorrhea, and (2) the possibilities of the seton when a rebellious tendency to reclosure of the canal is experienced.

Ware, in 1793, after puncturing an abscess of the sac, introduced a solid, uniformly small silver style with flattened head. He claimed that it acted by dilating the passage and guiding the tears, and asserted that a complete cure, in many cases, could be obtained after its use for a month or six weeks. It caused, he declared, no inconvenience, and that any fistulous opening present at the time of operation, speedily healed.

Bickerton (*Liverpool Med. Chir. Jour.*, Jan., 1906) introduces a silver tube with a horizontal shoulder and tapering end which rests in the divided canaliculus and prevents the tube falling from position. He first inserts a probe, but allows the tube to remain. He claims distinct superiority for his method in the treatment of all cases of chronic dacryocystitis, in which irrigation and occasional probing have failed to give relief.

Burton Cooper (*Ophthalm. Review,* June, 1906) recommends silkworm gut, twisted like a screw, with a silk loop at one end. The lower canal having been slit, a Galezowski dilator is introduced, the style inserted, and the loop brought out at the nostril, by the aid of mirror and speculum. The upper and lower ends are united over the cheek. On the following day the gut is cut on the cheek, and a small knob of sealing wax attached to each end. The upper, bent end of the style rests in the slit canaliculus.

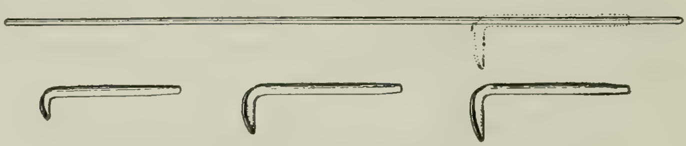
Pond (*Medical Record,* Feb., 1901) uses coarse silk thread as a drain. The thread is passed through the duct and its free end tied. The knot is drawn through several times a day to keep the passage open.

Koster (Graefe's *Arch. f. Ophthalm.,* Vol. LX, VII) draws a loop of fine wire, or threads made stiff with gum, through a previously inserted deWecker hollow probe. A silk suture is threaded on the wire loop, drawn up through the hollow probe, which is then withdrawn and the two ends tied into a flat knot, which may be drawn through the duct as often as necessary. This operation does not materially differ from Pond's.

Ramsey (*Trans. Otol. Sec., A. M. A.,* 1901) introduces a probe 26 centimeters long, one end blunt and the other with an eyelet large

enough to carry Number 14 silk thread through the nasal duct, and draws the blunt end out of the nose by forceps. The string is drawn through the nasal duct and the ends tied together. The patient is instructed to draw the string through the nose once the first day, twice the second day, and thereafter three times daily.

Krusius (*Zeitschr. f. Augenheilk,* Vol. XXII, 3, 1909, p. 230) secures permanent drainage by the following method: A tube closely enveloping a Number 2 probe is introduced into the duct, the probe removed and the tube, slightly retracted from its original position, allowed to remain. A dry catgut is then passed through the tube, its lower end caught, drawn from the nostril, and secured. Goebel (*Archiv. f. Augenheilk.,* Vol. 63, No. 1), to whom the idea of the tube and sound first occurred, used a silk thread instead of the catgut.



Silver Tube with Horizontal Shoulder. (Bickerton.)

The use of bougies in the treatment of nasal duct obstruction. Stilenitz (*Klin. Monatsbl. f. Augenheilk.,* May, 1900) and Antonelli (*Annales d'Oculist.,* Oct., 1901, p. 277), after slitting the canaliculus and dilating the duct, introduced by Holtz's method, medicated bougies composed of cocoa butter, or gelatine in combination with protargol, or other antiseptic.

Electrolysis has been advocated by Stevenson and Jessup, Gorecki (*Recueil d'Ophtal.,* 1889, p. 557), Lagrange (*Ann. d'Ocul.,* 1900, p. 252), and others, in the treatment of stricture. A Bowman probe, negative pole, is inserted into the duct, and a platinum canula, positive pole, placed in the nostril, or at the back of the neck, and an electrical current not stronger than 2 ma. is turned on for thirty seconds.

Lotion (*Archiv für Augenhlk.,* XL, pt. 2, 3) passes a 5 ma. current for five minutes, introducing the anode, a silver or platinum wire, into the fistula, and placing the cathode in the nares of the same side. McEnery Brown (*Annals of Ophthalm.,* April, 1910) does not approve Lotion's method, which is little used, and dismisses it with scant notice. He proposes, instead, that the negative electrode of a galvanic current be connected with the probe and passed into the duct, while a moist sponge, connected with the positive pole, is pressed on the patient's cheek.

The methods thus proposed are not commended by general observ-

ance. The truth is that electrolysis, in the present evolution of knowledge and experience, is of questionable utility in the treatment of stricture. It is, nevertheless, a future possible agency of great importance, and its precise value and applicability should be determined by further intelligent experimentation.

H. B. Harris (Wood's *System of Ophthal. Operations,* Vol. II, p. 1598) describes a simple operation for congenital atresia of the naso-lacrimal duct, as follows: "I am well aware that the lumen of the canal in most of these cases can be established or rendered patulous, when seen early, by simply passing a Bowman's probe. The case I wish to report, however, could not be so corrected at the time it came under my care. A boy four years of age, was brought to me April 2, 1909, with the history of a bad muco-purulent discharge from the right eye since birth, for which he had been treated with drops, probing and slitting .the canaliculus, for a long time following birth . . . I could not pass even a No. 8 Bowman, so decided to use a small trocar, canula and obturator. The canula was the size and shape of a number 8 Bowman's probe; the obturator and trocar fitted this. After cocainizing the lacrimal canal, the canula with the obturator was passed as far down as possible. Then the obturator was withdrawn, and the trocar passed into the canula and on down to the bony obstruction. Guarded pressure was then applied to the trocar, which was made to pass through the soft bone into the inferior meatus. The canula and trocar were now withdrawn and a number 8 Bowman's probe passed, and with little pressure, found its way into the meatus, following the path made by the trocar. The case went on to rapid recovery, and has remained well ever since."

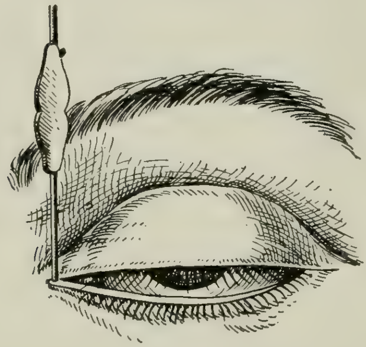
The simplicity of the operation, and of the instruments employed, the avoidance of general anesthesia and absence of any noticeable scar, are the commendable features of this operation.

Stricturotomy. Division of a stricture preliminary to treatment, is preferred by many surgeons. A Weber's knife is introduced, and its cutting edge used instead of the probe. Immediately after the reduction of the stricture by slitting a large probe, number 8 or 10 Bowman's, or Ziegler's, is inserted into the canal. Subsequent treatment is essentially the same as that just outlined.

The objections urged with greatest cogency against cutting the stricture, are based on the belief that cicatricial contraction is greater than by the divulsion method, and that the old stricture is more likely to reform and new ones occur. This is a debatable question. The cutting operation certainly facilitates subsequent probing, is more rapidly curative, and does not, in our opinion, sufficiently exag-

gerate the tendency to recurrent cicatricial formation or contraction to justify opposition to its employment. See, also, **Canaliculus knives.**

The accidents most likely to occur in either probing or slitting for relief of stricture of the nasal duct are injury to the mucous membrane tearing or cutting it with the point of the instrument, and the consequent creation of a false passage. This accident is likely to happen when one, not sure of the position of the instrument, drives it with unwarrantable force. The misdirected opening usually lies under the membrane and against the bone of the canal on its inner side, extending through the orbital floor, or perforating the lacrimal bone. Or the



A Bowman's Probe in Place after Passage along the Canaliculus into the sac and nasal duct. The point of the probe is in the inferior nasal meatus; the middle of the small plate on a level with the eyebrow. (Meller.)

instrument, having passed safely into the duct, may pierce the lining separating it from the periosteum, and descend into the nostril below the inferior turbinated bone. These accidents lessen the caliber of the anatomical passage by the formation of cicatrices and cause, rarely, a periostitis. When the bones are not diseased, the creation of an artificial opening is properly attributable to ignorance, inexperience or carelessness. In advanced necrosis, however, it is not always possible to avoid making a counterfeit canal into the nose or antrum through the lacrimal or superior maxillary bones.

Maddox (*Ophthalmoscope,* p. 99, 1911) as an adjunct to probing, etc., uses *metallic mercury* in the treatment of some forms of lacrimal stenosis. The sac is opened in the usual way and repeatedly washed out with a diluted solution of perhydrol. Metallic mercury is introduced and left there. It opens out the folds of the sac and by pressure tends to dilate the stricture. The probe, which should be well greased with vaselin to prevent the mercury from attacking it, may be passed while the mercury is still in the sac.

Permanent drainage by strands of thread in the nasal duct, the upper end of which is stuck to the forehead, the lower left free in the nose or brought out and tied to the upper extremity, has been recommended by Ostwalt (*Ann. d'Ocul.,* Vol. 146, p. 376, 1911). For this operation the following are needed: (a) A wire-threaded probe. This is a hollow canula not larger than a No. 3 or 4 Bowman's probe. Through it passes a very thin and very flexible silver wire terminating at its lower end in a polished silver knob of the diameter of the canula. By means of a locking-screw, placed at the upper extremity of the instrument, the silver knob can be held pressed against the lower end of the canula. The instrument can be passed along the lacrimal passages, like an ordinary Bowman's probe. (b) A pair of elbowed forceps with spoon-shaped ends. The small spoons of this pair of slip-forceps are arranged so that in closing they leave open in the antero-superior fourth of their circumference a small slit with blunt edges, large enough to leave the silver wire free and small enough to enable the silver knob of the first instrument to be firmly grasped in the spoons. The object of the instrument is to grasp the silver knob and to draw it and its silver wire attachment forward to the anterior nares after this probe has been passed into the lacrimal passages. (c) A pulley director. A nasal probe ending in a fork, between the prongs of which is a small pulley. Its use is to direct the silver wire when it is being drawn forwards and to prevent wounding of the mucous membrane. (d) A fixed nasal speculum. This is a modification of Vacher's speculum. By means of five joints, controlled by three screws, it can be used in any position, remaining firmly fixed. The upper joint is attached to a forehead band.

Before the operation, the conjunctival sac is freely cocainized and the lacrimal sac injected with cocain and adrenalin. Wool pledgets, soaked in a solution of 5 per cent. cocain with some adrenalin added, are inserted in the nasal cavity.

The operation itself is described in five stages: 1. The wire-threaded probe, with the knob fixed at its lower end, is passed through the superior canaliculus, the sac and the nasal duct. 2. The speculum is inserted into the same side of the nose and directed toward the middle of the lateral wall of the inferior meatus, i. e., towards the site of the lower opening of the naso-lacrimal duct. The wool pledgets are removed, and with the aid of a strong forehead mirror, the silver knob is looked for. If the surrounding area is swabbed with a wool pledget, and the probe moved up and down, the knob can generally be seen shining brightly under the reflected light. 3. The knob is seized with spoon-ends of the special forceps, which are closed on it.

4. The knob is drawn forwards horizontally to the opening of the nose and with it the silver wire. To avoid the latter wounding the mucous membrane the pulley guide is inserted, the wire running over the pulley in the fork. 5. The upper loop of the thread drain is attached to the silver wire above the knob by means of a slip-knot, the knob is withdrawn through the hollow canula, and, finally, the canula itself drawn upwards, bringing with it the upper loop of the drain, leaving the drain itself in the naso-lacrimal duct.

The drain is about 2½ centimetres long, and varies from six to twenty-four strands, according to the stage of the treatment; the strands are knotted at each end with as small a knot as possible, and to each is attached a loop, an upper and a lower, for manipulation. By experiment Ostwalt has satisfied himself, from the point of view of capillary and drainage power, as to whether silk, waxed linen thread, or Alsace thread is the best material for use, and concludes in favor of Alsace thread. The material is impregnated with iodoform (by immersion in ether saturated with iodoform) or by a disinfecting solution (glycothymolin for preference).

In treating a case, a drain of six to eight thicknesses is first used, replaced some days later by one of ten or twelve thicknesses, then sixteen to twenty, and, finally twenty-four. The canal is in this way dilated, little by little, in a manner painless to the patient.

The upper loop, holding the drain, is held fast on the forehead by courtplaster, the lower one is placed inside the nose. The loops should be washed daily with a disinfectant (1 in 5,000 perchloride of mercury solution), and, as often as possible, the lacrimal sac should be irrigated.

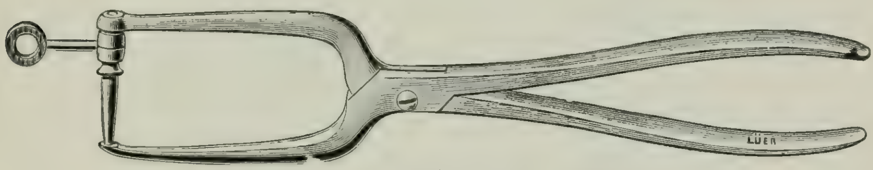
The subsequent drains are inserted by drawing down the one in use, cutting it off at its junction with its upper loop, and attaching to the latter the upper loop of the new drain, which can be thus drawn into place.

If suppuration continues, the author injects five or six times a solution of 1 per cent. silver nitrate, repeating it every two or three days. The solution is made to pass along the length of the drain.

In the cases in which the bony wall is not concerned, the drain is allowed to remain for a month, and where this structure is altered, for from six weeks to two months.

In *Foroni's* (*Annali di Ottal.*, Vol. II, p. 392) *operation* the lacrimal canaliculi, beginning with the lower, are completely incised with a Weber knife, as is also the external wall of the lacrimal sac as it lies between them. The opening is increased, and the deep palpebral ligament incised, and some tissue is resected at the combined entrance of the two canaliculi into the sac. The Weber knife is carried repeat-

edly through the naso-lacrimal duct to the floor of the nose (stricturotomy). A Bowman sound is left in the duct for some seconds, after which it is replaced by a strip of gauze impregnated with a 1:1,000 solution of oxycyanid of mercury, the gauze being carried to the floor of the nose. The drain is renewed daily for a period of from one to two weeks, according to the time required for healing. Excellent results are claimed for the treatment, which the author has used in over a hundred cases.



Punch for the Lacrimal Bone. (Morax.)

De Wecker's Lacrimal Sound and Syringe with Intermediate Rubber Tubing.

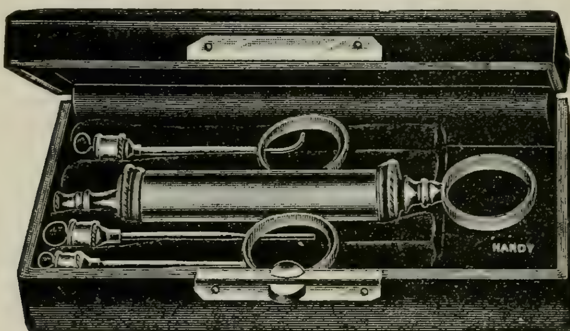
OPERATIONS ON THE LACRIMAL SAC.

As pointed out under **Dacryocystitis** the successful treatment of several common affections of the lacrimal apparatus may demand operative interference with the sac itself. An important measure is *obliteration or destruction of the sac in situ.* Gifford's method of accomplishing this is a very effective and satisfactory procedure. It is described on p. 3719, Vol. V, of this *Encyclopedia.*

In Scheffels' (*Klin. Monatsbl. f. Augenhlk.*, p. 275, April, 1901) operation both canaliculi are slit and all strictures divided at the sac entrance. The operator then cauterizes the cavity with Vienna paste moulded in the form of a small ball and wrapped in a thin layer of cotton, which he places at the bottom of the sac. He removes this mould in two minutes, cleanses the sac, packs it with cotton, and protects the eye with vaseline dressing.

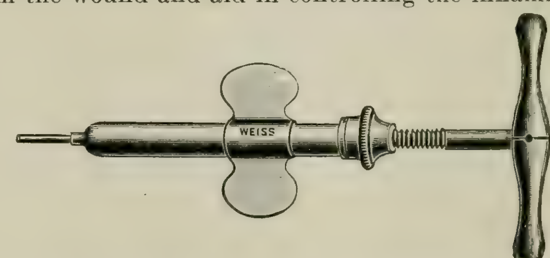
Incision of the tear sac is generally performed to open an abscess and to establish drainage in acute dacryocystitis. The lower lid is stretched toward the temple, as when a probe is introduced. A sharp, pointed, small bistoury, its cutting edge downward and slightly outward, is thrust through the center of the swelling and all tissues, down to the median wall of the sac, are divided. The normal topography

of the parts is much altered in acute diseases of the sac, and the points anatomically used as guides cannot be relied upon. Exit of pus affords positive evidence that the sac has been tapped, but the surgeon should not be satisfied with the small opening necessary to confirm the diagnosis. The knife, having touched the median wall of the sac, should be pressed downward, dividing the swollen tissues for several



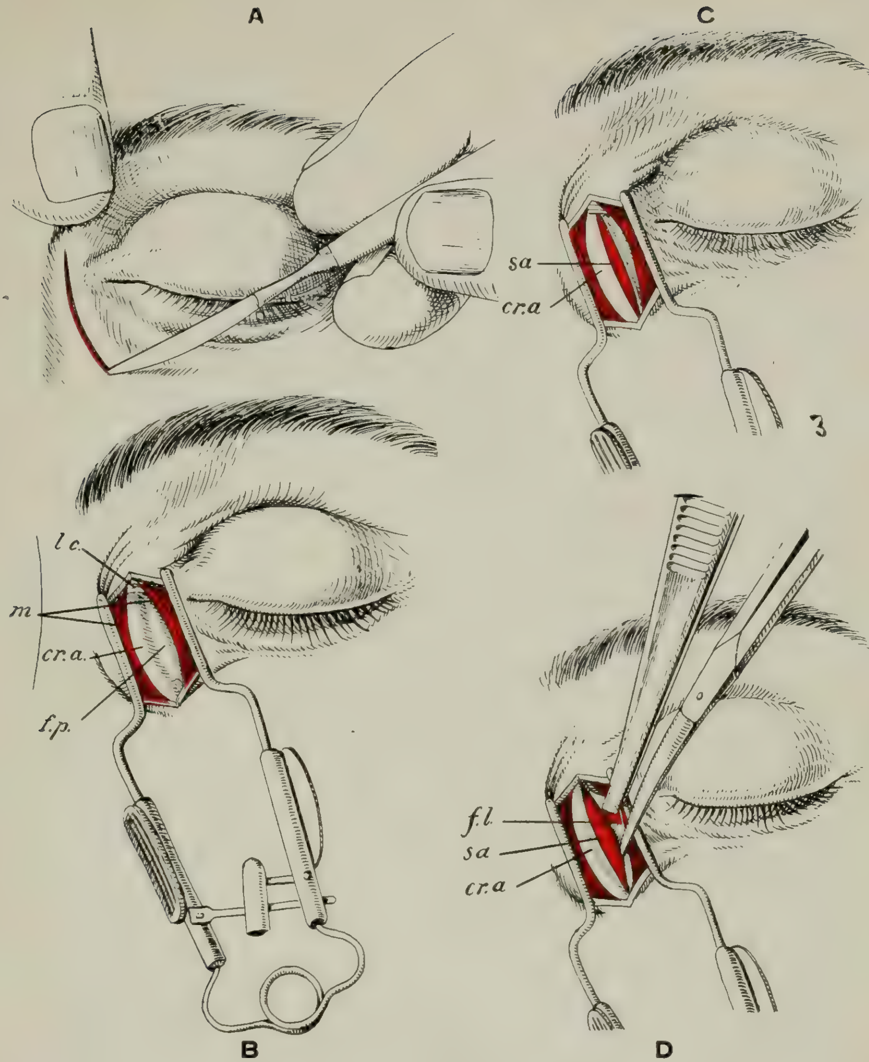
Anel's Syringe for Irrigation of the Naso-lacrimal Duct.

millimeters, and so establish an opening large enough for the insertion of a drain—rubber tube or iodoform gauze. The rigidity of the tube sufficiently supports it in position; the gauze is pushed into place with a probe. Before the insertion of a drain, the sac and its adjacent tissues should be freely washed out with an antiseptic. After the drain is in place, hot bichloride dressings, repeatedly applied, will encourage discharges from the wound and aid in controlling the inflammation. The



Treacher Collins' Syringe, with Screw Action, for Injecting Cold Paraffin Wax into the Lacrimal Sac for the Purpose of Outlining the Latter Previous to its Removal.

operation is a painful one, but so soon executed that general anesthesia is exceptionally necessary. However, when the operation is incomplete without division of the canaliculi and the passage of probes, anesthesia by ethyl-chloride, or nitrous oxide gas, is advantageous. Bleeding is rarely serious, though it may be profuse.



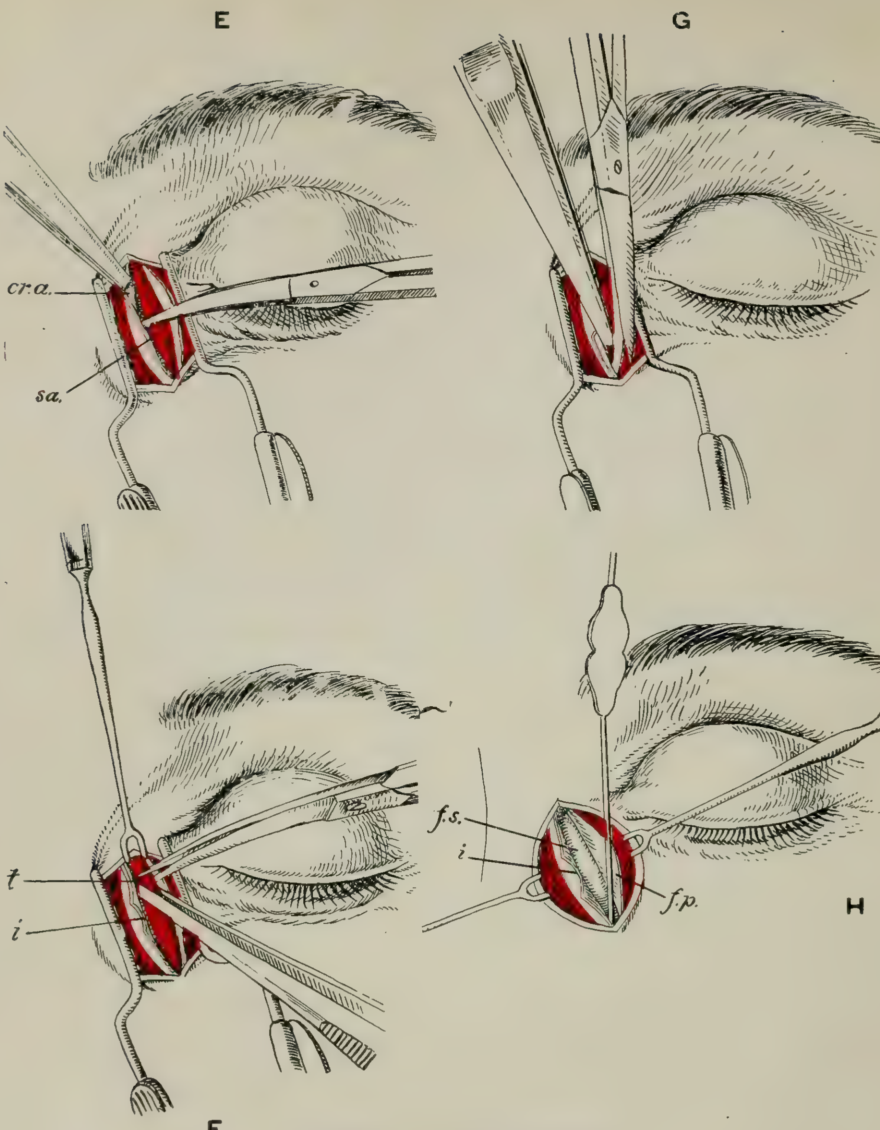
Excision of the Lacrimal Sac.

A. The skin towards the inner canthus is fixed by the thumb of the left hand so that it cannot be pulled or stretched when the slightly curved incision is made from above downwards. The cut is placed about 3½ mm. from the inner canthus (After Meller.)

B. The sac is to be found in the deep wound (f.p.) on separating the fibres of the muscle (m.). The internal canthal ligament (l.c.) is seen in the upper angle of the wound. The anterior lacrimal crest (cr.a.) can then be felt and sometimes seen. (After Meller.)

C. The incision is now made through the deep fascia and the whole length of the wound about 1 mm. behind and to the side of the anterior lacrimal crest (cr.a). The lacrimal sac (sa.), of a reddish-blue color, should now be seen. The incision also cuts through the internal canthal ligament. (After Meller.)

D. The margin of the wound in the fascia (f.l.) is grasped by forceps. With the closed arms of the scissors the loose connective tissue the sac (sa.) and the deep fascia are separated. (After Meller.)



Excision of the Lacrimal Sac.

E. An incision is now made in the margin of the fascial wound about its center, exposing the anterior lacrimal crest (cr.a.). After this cut the closed scissors are readily passed between the bone and the sac (sa.), so as to loosen the latter. The scissors point is always directed towards the bone beneath. (After Meller.)

F. The sac (f.) having been freely separated from the surrounding structures is seized by the forceps near its apex and is further lifted from its bed by short cuts of the scissors, keeping as close to the sac wall as possible. The superior margin of the wound is drawn upwards with a pointed hook. (After Meller.)

G. The sac is now seized with the forceps at its inferior end, after it has been separated from the surrounding tissues. By means of the scissors all the neighboring parts are cut away as far as the lacrimal duct. (After Meller.)

H. The field of operation after completion of the excision. The lacrimal fossa (f.s.) is empty, its external border being formed by the deep fascia (f.p.). At this point it is attached to the posterior lacrimal crest. A probe is passed through the duct to the nose. The skin edges of the wound are held apart by double tenacula. (After Meller.)

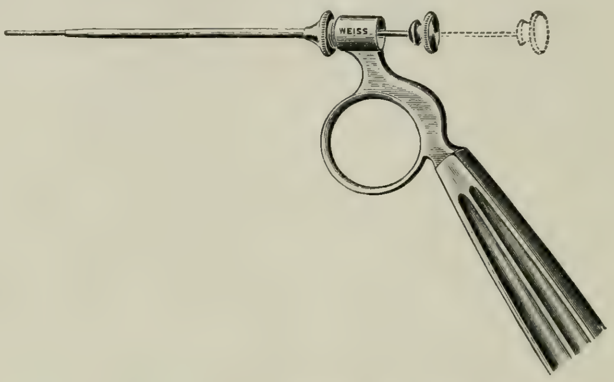
Excision of the lacrimal sac. This operation is indicated where mild measures have failed to relieve a lacrimal obstruction; also in tuberculosis and lupoid dacryocystitis; in chronic inflammation and dilatation; in polypoid degeneration; when the surrounding bone is diseased; when an operation is to be performed upon the globe; in fistula, after other and less grave measures have proven ineffective; for the protection of an eye frequently exposed to injury; in severe ulceration of the cornea accompanied by an infected or obstructed lacrimal passage; when the patient is unable or unwilling to remain under the surgeon's charge, or bear the pain of frequent probing; in bilateral dacryocystitis following the loss of one eye from infective keratitis; in malignant growths; in blennorrhea of the sac in patients suffering with trachoma; in mucocele incurable by other measures; incurable obliteration by traumatism or disease of the nasal duct.

Removal of the sac was probably first attempted in 1724 by Platner, but he made a false passage into the nose and, perhaps, for that reason he had few followers. An unsuccessful attempt to revive the operation was made by Rosas in 1830. In medical literature, prior to 1868, the operation is mentioned by Arlt and de Wecker, and was performed by Mooren, who did not recommend it. Berlin (*Bericht der Ophthal. Gesell.*, 1868) reintroduced the operation.

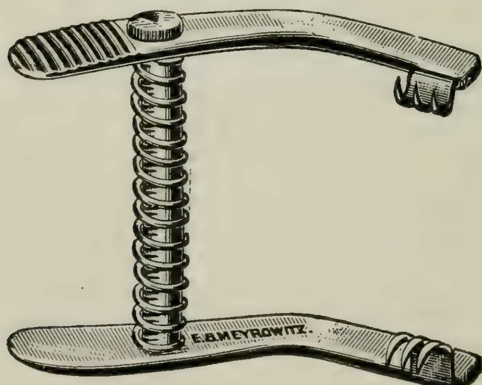
Celsus, A. D. 50, referring in his *De Medicina,* to the treatment of lacrimal fistula, advocated cutting the tissues down to the bone and cauterization by hot iron or escharotics. Other and equally barbarous methods were, through ignorance of the function of the sac, in vogue until Anel, in 1712, passed a fine silver wire through the punctum and injected fluid into the sac and duct by means of his syringe. And his method, modified mechanically and in the medicaments employed, is in use at the present time. New procedures came into fashion about 1730: notably perforation of the skin, sac and bone by a single operation, and prevention of healing by insertion of hollow tubes of lead, silver or gold; simple incision, after which the *os lachrymale* was broken through by sharp-pointed and crooked forceps, the aperture enlarged and closure prevented by the introduction of a curved style. St. Yves' plan was to incise the skin one day, perforate the *os unguis* with a trocar the next, and then insert tents of lint and wood.

Pott correctly determined the true origin of the disorder, which was due, he affirmed, to obstruction of the lacrimal sac or duct, and not to caries of the bone. He suggested treatment by frequent expulsion (with the finger) of the contents of the swollen sac, to prevent stagnation; the use of an astringent lotion to control suppuration; simple incision of the abscess and use of Anel's syringe; incision and dila-

tation of the duct; temporary introduction of a silver or whalebone probe, bougie, or catgut; the formation of an artificial passage by boring through the *os unguis* with a probe, gimlet, or curved trocar, and the daily insertion of a plated or leaden canula. Wathen, in 1781, proposed to secure a permanent communication, without breaking through the bone, by introducing a hollow metal tube or canula into the nasal duct, believing, he states, that "the restoration of the natural duct affords the only rational prospect of success."



Gault's Canula for Injecting Cold Paraffin Wax into the Lacrimal Sac, for Outlining the Same, Preparatory to Excision.

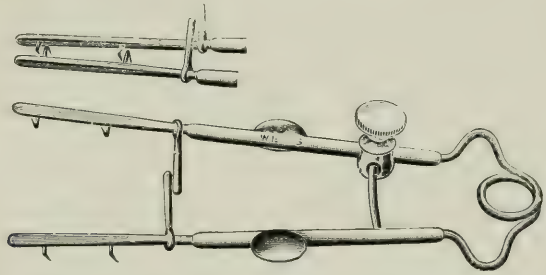


Axenfeld's Lacrimal Sac Retractor.

For separating the skin edges of the incision and to permit easy manipulation of the tissues below the skin in excision of the lacrimal sac.

The sac may be *outlined*, as a preliminary to its excision, either by filling it with paraffin (medium soft) by means of a syringe or by passing through the canaliculus a strabismus hook with its point directed upward; the hook may be readily felt in the wound by the

finger as it raises forward the anterior wall of the sac. There is no difficulty in inserting the Müller wound speculum with the hook in place.



Snell's Lacrimal Sac Retractor, with Revolving Blades.
Used in separating the edges of the skin incision in excision of the lacrimal sac.

Lotel's (*Archives d'Ophtal.*, p. 170, Vol. 32) hook is an ingenious instrument for outlining and determining the exact locality of the sac. It is shaped like a strabismus hook and has a second movable branch. The closed hook is pushed into the sac, through the upper canaliculus, which has been previously slit. By pushing at the end of the handle, the prongs separate and their extremities can be easily felt and serve as guides to the incision, which is made and carried 1 mm. above the internal palpebral ligament. The sac is separated from the adjacent tissue and a silk ligature passed at the nasal end of the sac and the hook is withdrawn.

Stevenson's Lacrimal Clamp.
For use in excision of the lacrimal sac.

Seidel has devised a new method of *local anesthesia for extirpation of the lacrimal sac,* insuring complete anesthesia and anemia without any edema of the operative field. The principal difference from infiltration anesthesia lies in the fact that the field of operation is not anesthetized but the conduction of the sensitive nerves of the tear sac is intercepted, viz., the nasociliary nerve and its terminations, the ethmoidal and the infratrochlear nerves. After filling the sac with a 2 per cent. novocain solution, an injection is made with a needle, 2.5 cm. long, at the anterior ethmoidal foramen, as follows: 0.75 cm. laterally from the intersection of the orbitopalpebral sulcus with a

vertical line through the medial commissure, the palpebral fissure being held open. The needle is introduced horizontally through the upper lid 2.5 cm. backward and to the medial side. The lower place of injection lies close above the infraorbital margin a little inward from the infraorbital foramen. The needle is directed upward and inward through the lower lid to the medial orbital wall. In all 2 c.c. of the solution are injected.

The *prognosis* in extirpation of the sac is generally favorable. Elliott (*Ophthalm. Record,* Feb., 1908) reports 310 operations; Dewey (*Ophthal. Record,* Feb., 1908), 29. These operators, both of extended experience, give favorable results. Toole (*Brit. Med. Jour.,* 1906) operated on eleven cases without a failure. "We know," he says, "from actual experience, that when the source of infection has been removed, irritation of the conjunctiva is allayed and that reflex irritation to tears is not produced."

The conditions most frequently contributing to failure in this operation are extensive involvement of the bones, muco-purulent infiltration of the soft tissues, and to the operator's inexperience, lack of skill, or lamentable ignorance of the anatomy and pathology of the structures invaded. Following the operation, the secretion of tears gradually diminishes and is hardly noticeable after the lapse of six or eight weeks. This fact is due, probably, not yet demonstrably, to the impression made upon the innervating nerves. Should epiphora continue as a complicating annoyance, the accessory lacrimal gland should be removed.

The occasionally recurrent statement that atrophy of the gland follows extirpation of the sac, is without proof. Axenfeld (*Bericht der Ophthalm. Gessell.,* 1900, p. 160) and Bietti have shown that there are microscopic indications of atrophic changes, fat tissues and granules, in the normal gland. They examined sections of glands in numerous cases where the sac had been previously excised, but found no further evidence of degenerative changes.

The technique of excision of the lacrimal sac. Among the necessary prerequisites to the correct performance of this operation, must be included the surgeon's working familiarity with the anatomy of the parts involved.

The sac lies in the groove of the lacrimal bone, and is protected on the nasal side by the nasal process of the superior maxillary bone. The anterior lacrimal crest, a prominence on the nasal process, is in front of and partly overlies, the lower third of the sac. The posterior lacrimal crest, the delicate thin edge of the lacrimal bone, is situated behind and above the upper portion of the sac. The tendo-oculi,

internal canthal ligament, arises from the upper extremity of the nasal process and is divided into two portions, attached separately to each tarsus. The attachments cover the upper portion of the sac. Back of the sac, attached to the post-lacrimal crest, is the muscle of Horner. Posterior to this muscle, which separates the tissues mentioned from the orbit, is the orbital fascia.

The incision.—With a sharp, straight, convex-edge bistoury, incision through the skin is begun at a point 2 millimeters above the ligament of the internal canthus and 3 or 4 millimeters to the nasal side of the inner extremity of the canthus and carried straight downwards for a distance of about 1½ centimeters. Kuhnt's (*Zeitschr. f. Augenheilk.*, 1902, p. 441) incision extends downward and outward for 20 to 25 millimeters along the margin of the orbit. Axenfeld (*Bericht der Ophthal. Gesell*, 1905, p. 232) incises 3 millimeters in front of the lacrimal crest. Landolt (*Ophthal. Klinik.*, Jan. 20, 1907) prefers to begin the incision 7.5 millimeters above and 15 millimeters from the inner angle, with a 2 millimeters curve toward the eye.

The preliminary incision must be large. It should begin about 1 centimeter above the tendo-oculi and pass downward along the crest of the ascending process of the superior maxillary, curving outward to the junction of the inner and middle third of the inferior border of the orbit. The length of the cut through the skin will be about 4 centimeters. By careful dissection, the surgeon lays bare the anterior lacrimal crest, separating the wall of the sac from the underlying bone. This may be done with a scalpel. The edges of the wound are separated as widely as possible and held by Müller's (or a similar) speculum. All superficial fascia, the palpebral portion of the orbicularis muscle, and the dense white subjacent or deep fascia, are carefully dissected away until, step by step, the sac is exposed. Its upper portion is still concealed by the ligament.

During the dissection, the operator should be guided by the position of the anterior lacrimal crest, and "by not dissecting too near to the median line, he will, on the one hand, escape the mistake of incising the periosteum of the dorsum of the nose, instead of freeing the lacrimal sac, and, on the other hand, keep from going in the wrong direction from the sac toward the orbit." (Meller). The delicate, posterior lacrimal crest does not come into view, it should be remembered, until the deep fascia has been removed. The surgeon, with closed scissors, now carefully separates the temporal side of the sac from the deep fascia, and divides the openings of the canaliculi close to their connections. By means of a strabismus hook, the entire length of the sac is easily detached from its groove. Its upper extremity is

still firmly held down by the ligament and the surgeon, at this step in the dissection, must be on his guard and keep close to the sac, avoiding the large blood vessels, numerous in this situation. The sac is lifted from its bed, firmly held by forceps, and its prolongations into the nasal duct divided by scissors. The duct is probed, cicatricial formations divided and curetted, and diseased portions of bone or membrane removed. The cutaneous wound is then closed by two or three fine silk sutures. Great care should be exercised in bringing the edges of the wound into close apposition. If the sac has been thoroughly removed, and proper precautions against infection observed, the wound usually heals by first intention. No drainage, aside from that afforded by the nasal duct itself, need be provided.

The toilet of the wound is simple. A small pad of antiseptic gauze is placed over the closed lids and a roll of the same material pressed firmly against the wound, to insure obliteration of the groove from which the sac has been removed. This swathing is held in place by additional layers of gauze secured by a roller bandage. The patient is confined to bed, and told not to disturb the dressing. The day after the operation, should there be no complaint of pain, or evidence of hemorrhage, the bandage need not be disturbed. Landolt (*Die Oph. Klin.,* Jan. 20, 1907) packs the wound with iodoform gauze, which is withdrawn on the second or third day, and removes the sutures on the seventh or eighth day.

If the patient complains of discomfort in the region of the wound, the dressing should be removed and the parts inspected. Gently applied pressure on the lacrimal bone may expel through the canaliculi, more frequently the lower, a small quantity of bloody serum, not previously drained through the duct. After expression of this accumulation, the feeling of tension usually subsides. This procedure should be repeated as often as the wound is dressed. On the third day the bandage and pads should be removed without disturbance of the gauze over the sac, and on the following day, the entire dressing, including the sutures, may be removed.

J. J. Thompson (Wood's *System of Ophthal. Operations,* Vol. II, p. 1602) describes a method for the removal of the lacrimal sac which, he claims, renders the operation extremely simple: "Cutting down on the sac and removing it in its entirety to me, seems very difficult, because there are no definite landmarks to guide one. When paraffin is resorted to, that agent frequently passes into the nose, especially in cases where Bowman's operation has been done, and large probes have been passed; or, on the other hand, if a stricture exists, it backs up through the canaliculus around the point of the syringe. What

seems a more simple method is thus: When the canaliculus has not already been cut, do so, and then introduce a small Theobald probe and leave it in place. This gives a good idea of the position of the sac, and the bony foramen that it fills. The usual curved incision is then made, beginning about 1 centimeter above the tendo-oculi, and extending downwards and outwards about 2½ centimeters below it.

"This incision, below the tendo-oculi, should reach as deep as the sac wall, and the overlying structures should then be dissected from it for a short distance on each side. As soon as the nasal process of the superior maxilla is exposed, the point of the hook which I have had made for the purpose should be passed into the foramen beside the nasal duct. If it is then turned at right angles and forced to follow the margin of the foramen outwards and behind the Theobald probe, it will come out just to the outer side of the sac, and by drawing upward on it one can be assured that it is really behind the probe and the sac. A heavy piece of silk is then threaded into the eye which is made in the hook for that purpose, and drawn around behind the sac. This ligature is tied as far down as possible, while at the same time the probe is withdrawn. We are thus enabled to tie the sac off at its lowest part, and if it contains pus, infection of the wound may be avoided. By rubbing the hook up and down a few times before withdrawing it, the sac is readily freed from its posterior attachment. Now, while drawing up on the ligature, the junction of the sac and nasal duct is cut across well within the bony canal, and by keeping the ligature tight, with a few strokes of the knife the sac is separated from the surrounding structures, as high as the tendo-oculi.

"Traction downwards is then made on the ligature, and with the point of the knife the dome of the sac is dissected from beneath the internal palpebral ligament, leaving it intact. The nasal duct is now curetted, and a pledget of cotton soaked in 95 per cent. alcohol is pressed into the cavity to stop bleeding and act as an antiseptic. The wound is then sutured and aristol blown over it, after which the canaliculus is cauterized with the galvanic cautery or platinum tip. A small roll of gauze is placed over the wound, and held in position by a pressure bandage to force the skin against the underlying structures, and primary union may be expected."

Cirincione, after making the usual incision, as described above, with a specially devised knife, divides the aponeurosis which fixes the sac to the bony orifice and separates the mucous canal from the periosteum. This part of the dissection is almost impossible without a knife so devised that its shaft is twice bent at right angles, a mechanism which brings the blade in parallelism to, and only a litttle distance

from the plane of the handle. Both edges are sharp with rounded points. When the whole canal is finally freed from its attachments, the mucous membrane is divided at its junction with the inferior meatus of the nose, and both sac and duct drawn away together. Sometimes it is not possible to detach, in this way, all parts of the canal. If the bony duct be small, the surgeon may succeed in removing only the upper part of the mucous membrane. In this case, the remaining part should be destroyed by the introduction of a galvanic cautery. Should it be necessary, the canaliculi are closed by the cautery, the surface wound sewn up, and a pressure bandage applied.

Accidents during excision of the sac. To avoid possible erosion of the cornea, the commissure should be closed during the operation, as exposure subjects its surface to injury and infection. Either of these conditions is a serious complication, likely to eventuate, if not promptly checked, in necrosis of the cornea and loss of the eye. For this reason, cocain and adrenalin should not be employed. The rule applies with lessened force to the employment of a general anesthetic, although ether or chloroform inadvertently dropped into the conjunctival or lacrimal sac, already aggravated by altered secretions, may light up a purulent conjunctivitis, or a sloughing ulceration of the cornea. Erosion of the cornea may also be produced by the curved points of the speculum in its bungling adjustment within the wound, or by the careless handling of other instruments.

Hemorrhage during excision of the lacrimal sac. The position and relation of the blood vessels in the area of operation clearly define the necessity of making the incision with due regard to the anatomical relations of the route pursued through the tissues; that is to say, not too close to the nasal side of the orbital border, in which situation lie the nasal and angular arteries and veins. Profuse bleeding is also the likely result of careless dissection around the upper border of the sac. In the event of hemorrhage, and it is sometimes unavoidable, the smaller vessels should be compressed against the nasal bone, and bleeding from the larger ones controlled by torsion. Capillary outpouring into the field of operation is readily checked by adrenalin and hot water douches.

Retention of a part of the posterior wall of the sac exceptionally occurs in necrosis of the lacrimal bone, and in partial destruction or friability of the sac. It more frequently follows separation of the upper portion of the sac, which is closely adherent to its fibrous attachments, from which it must be carefully detached with sharp-pointed scissors. The lacrimal bone, after removal of the sac, must

be closely inspected, and the remnants either caught by forceps and cut away, or the entire surface curetted.

Retention of the smallest part of the mucous membrane is likely to result in failure of the operation, due to muco-purulent discharges into the wound, hypertrophy of its epithelium, or to its investment by granulations, which establish a connecting link between the conjunctival sac above and the nasal duct below, distending the wound and forming a fistulous opening.

Should purulency of the wound be suspected, the sutures must be removed and the retained secretions allowed free exit. The wound should then be thoroughly cleansed with a weak blichlorid solution, and loosely packed with iodoform gauze. Curettement at this time, Meller declares, is of no appreciable service, as "it is impossible, during the period of granulation, to recognize all the details of the wound." Should a fistula form, it must be completely excised, and the fossa thoroughly cleansed and allowed to heal by granulation.

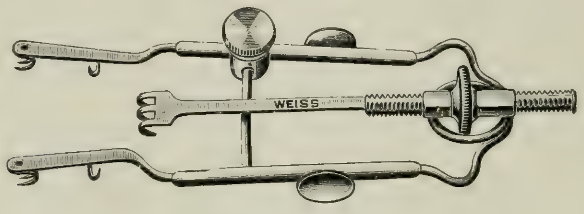
Pfalz (Michel's *Jahresber. für Ophthal.*, 1901) suggests that "on both sides of the freshened fistula, two vertical incisions, 5 millimeters apart, be made, and a double-needled suture entered in one wound and brought out from the other in such a manner that one thread passes above and the other below the fistula. By tying the ends, these subcutaneous sutures surround the fistula."

Incision into the orbital fossa during excision of the lacrimal sac. This accident is at once recognized by the protrusion of orbital fat into the field of operation. It is usually accompanied by profuse hemorrhage. Ordinarily, its only disadvantage to the operator is the delay imposed by excision of the fat and control of the hemorrhage. The chief ultimate danger lies in the possible infection of the orbital connective tissue and possibly purulent meningitis.

General anesthesia as a prelude to excision of the sac is advisable only in patients of extremely nervous temperament, necrosis of the bone, or when an extensive operation is in contemplation. Local anesthesia and anemia of the tissues, induced by injections of cocain and adrenalin, suffice in most instances. For this purpose, Meller employs with satisfaction a Pravaz syringe of 1 cc. capacity, containing eight parts of 1 per cent. solution of cocain, and two parts of adrenalin solution (1-1,000). Landolt's solution is practically the same; nine parts of a 1 per cent. solution of cocain, to one part of adrenalin, 1-1,000. Meller first injects one-third of its contents below the tarsal ligament, the second third above the ligament, and discharges the remaining third close to the orifice of the nasal duct. Czermak advises only one insertion of the needle, 1½ centimeters below and

outward from the inner angle of the lid. First a few drops are injected, the needle is then slowly pushed outward and upward under the skin to about 1 centimeter above the tarsal ligament and several more drops injected. He then partly withdraws the needle, and so changes its direction that the remaining portion of the solution may be injected under the ligament and fascia to the lateral side of the sac, thus anesthetizing its median wall. The conjunctival and lacrimal sacs and canaliculi should, he contends, be anesthetized by injection of cocain, using the ordinary lacrimal syringe for the purpose.

Harman (*British Med. Jour.*, Nov. 9, 1909) describes the use of his retractor (see figure) as follows: In inserting the new retractor the instrument should be first closed, the blades approximated, and locked by the turn of the side check-screw and the long claw pushed home



Harman's Lacrimal Sac Retractor.

to just behind the side prongs of the lateral blades. The claws are inserted into the wound just as in using Müller's instrument. Now the side check-screw is released, and the blades being forced apart by the spring of the frame stretch the incision laterally; the side check-screw should now be firmly locked. The blades are then gently pressed into the wound by one finger, and the milled nut at the spring end of the frame turned so as to draw back the long claw; the front claws on the blades are pivoted and so shaped that they oppose the backward drag of the long claw, so that the incision is stretched tight. The field of the operation is well exposed, and the traction exerted on all sides of the wound acts as a most efficient hemostat, yet the important upper limit of the wound is left quite free of any obstruction that would hinder the work of the surgeon.

In Maynard's method, after separating the sac with the periosteum on its inner side he cuts through the nasal duct as low down as possible, and then with scissors he dissects the sac upwards, removing last the upper domed end of it, the most difficult part of the sac to remove.

McMillan makes the first incision through the skin only, as this to a great extent avoids the profuse hemorrhage, and then uses a little curved blunt dissector to tear through the tissues and to delimit the

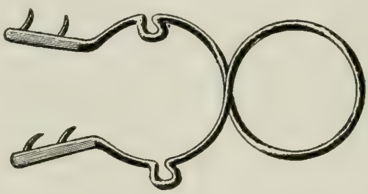
sac. He calls attention to the importance of probing the nasal duct after removal of the sac.

In the procedure originally advised by Elschnig (*Die Oph. Klinik,* Jan. 20, 1907) 1 per cent. solution of cocain in a Pravaz syringe, to which adrenalin has been added, is injected in the following manner. The needle is inserted over the anterior lacrimal crest and directed upward and slightly inward subcutaneously for about one-third of an inch, and a few drops of the solution injected. The syringe is withdrawn and the needle is again pushed to the bone just below the middle part of the canthal ligament and is directed downward, and the second third of the anesthetic mixture used, thus cocainizing the lower part of the sac. The same procedure follows, above the ligament, the needle directed slightly upward, the part is gently massaged for a couple of minutes and then the operation may be begun, for when properly administered nearly complete anesthesia results.

With a scalpel the first incision is made, cutting only through the skin, from a point above the middle part of the canthal ligament and running downward and slightly outward over the crest. This bony prominence forms the chief landmark during the operation and its location must be constantly borne in mind. The edges of the skin wound are now slightly undermined and a Mueller speculum inserted to hold them apart. The floor of the opening is formed of the delicate superficial fascia, and this is easily divided with the point of a pair of scissors. A toothed thumb forceps and light scissors curved on the flat are now taken up by the operator and the muscle fibers of the orbicularis separated easily by blunt dissection, as these fibers follow the line of the incision. During this period an assistant keeps the field of operation free from blood, using forceps and a strip of gauze for tamponading. The opening is now quite deep in many cases, and below the tough, deep fascia can be plainly made out. Just over the crista a snip is made into this fascia with the point of the scissors, and then inserting one blade into the opening a straight incision can be continued up to the canthal ligament. This ligament may now be severed to enlarge the field, but when done earlier there is a tendency toward hemorrhage from the large veins lying just above. Between the edges of the split fascia lies the pink sac. The fascia is grasped in the forceps to the outer side, and with closed scissors the wall of the sac is gently dissected away from the orbital fascia, taking care to avoid penetrating this, lest a hernia of fat should obscure the view and even lead to a subsequent cellulitis. The nasal edge of the fascia is then fixed and with the scissors the inner wall of the sac is freed from the periosteum of the lacrimal bone. The

canaliculi are divided close to the sac and the under surface is easily freed by the blunt dissection close to the bone. The assistant now retracts the upper angle of the wound by means of a small sharp double hook. The body of the sac is firmly grasped with the forceps and the vault dissected loose with a few cuts of the scissors, keeping close to the bone, and now only the connection with the lacrimal duct remains. With the sac between the blade, the scissors inserted into the duct and the cut made as low down as possible.

The sac comes away and a sound is passed through it to determine whether it is intact or not. In most cases a gratifying result is realized. A large Bowman sound is passed into the duct through the wound opening and this followed by a sharp curette with which the entire diseased mucous membrane is extirpated. The cavity is washed



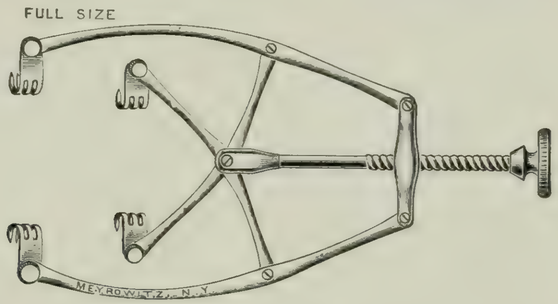
Polack's Lacrimal Sac Retractor.

with 1-1000 bichlorid and dried with gauze. The skin margins are made tense by traction upon sharp hooks in each angle and three silk sutures bring the edges together, good apposition being most desirable, for in such a case the scar is never visible. A piece of gauze with vaselin is laid above, and a small roll of iodoform gauze is used to exert pressure over the area, thus obliterating any of the dead spaces. A compression bandage is applied; the patient leaves to return in two days, provided there are no symptoms. Sutures are removed on the third day, a little dusting powder, preferably xeroform, and the case is completed. Uninterrupted recovery occurs in a week.

Pooley prefers to have his patient under a general anesthetic. He then thoroughly dilates both puncta and passes a probe along the canaliculus into the sac. He washes out the contents of the lacrimal sac with a syringe and injects a 1 per cent. watery solution of methylene blue into it. He makes a curved incision from above downwards, with its centre about one-third of an inch on the nasal side of the inner canthus. He carries this down to the tendo oculi, which he divides. He then separates the sac from the periosteum below with a blunt dissector, or with scissors, if there are adhesions, and, after isolating it as far as possible on the nasal side, divides it below, turns it up and

removes it in the ordinary way, dividing the canaliculi. He then scrapes the bony part of the lacrimal canal with a small, sharp spoon. The wound edge retractor is then removed and he picks up the end of the probe which is in the wound with forceps; with a few snips of the scissors, carefully keeping the points very close to the probe, he frees the attachments of the canaliculus on its deeper surface.

The canaliculus is separated from the conjunctival surface and then, holding the end of it with a pair of fixation forceps, he frees it all round, seizes the end and divides it, either close to the punctum or in its outer third, after removing the probe. The upper canaliculus is treated in the same manner. Next a catgut or silkworm gut suture unites the deeper part of the wound, including the orbicularis muscle and the tendo oculi, to the periosteum on the nasal surface. He prefers

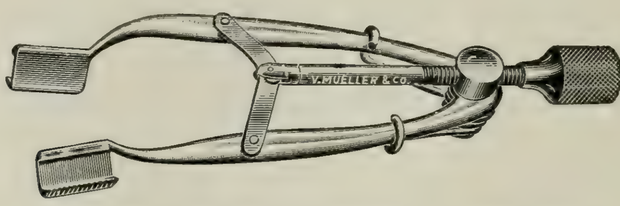


Stephenson's Lacrimal Sac Retractor. Earlier Model.
For separating the edges of the skin wound in excision of the lacrimal duct.

a continuous suture (such as is usually employed for subcuticular suturing) and brings the two ends of it through the skin at the upper and lower extremities of the incision respectively. If necessary, a deep catgut and a superficial silkworm gut suture can be used; the ends of the sutures may be either fastened to the skin by plaster or tied to the ends of an interrupted suture which in that case is placed at each end of the wound. The catgut sutures are left to absorb, the silkworm ones can be easily removed by pulling on one end.

Pooley points out how certain postoperative difficulties and dangers incident to both his own operation and to other procedures of the sort may be avoided. Unsightly scars are best avoided by keeping the incision as near the inner canthus as possible; and by suturing the tendo oculi to the nasal periosteum, or by uniting the two ends of it. Hemorrhage during the operation is not a serious bar to the success thereof. It is usually most troublesome in cases that have been recently acute, and can usually be controlled by sponging with

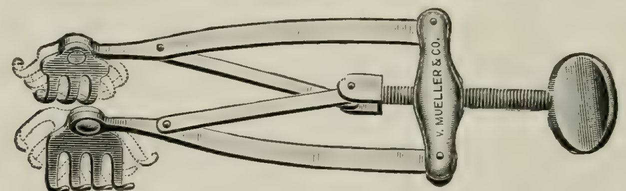
adrenalin. It is a mistake to waste time in arresting hemorrhage, since it generally stops when the operation is completed. In excising the canaliculus care should be taken not to wound either conjunctiva or skin. Sepsis does not often happen, but Pooley advises that the skin be painted, before the incision, with a solution of iodine in spirit, while the surrounding area be shut off by gauze whilst suturing.



Stevenson's Lacrimal Sac Retractor. Latest Model.

Derrick Vail's (*Ophthalmic Record,* July, 1915) instrument (see figure) is constructed from Allport's mastoid retractor, the working ends of which were removed and swinging "hands" substituted.

After the incision the periosteum is stripped back a short distance



Vail's Lacrimal Sac Retractor.

and the "finger" ends of this retractor are inserted vertically, so that the deepest tissues will be engaged with the arms closed. The "fingers" dovetail to permit easy application through the smallest incision. The screw is then used to separate the arms and when the bone is well exposed, the instrument is "broken" at the "wrists" and made to lie away from the field of operation by simply turning it to either side like a lever. Bleeding is thus at once controlled and the field is well exposed, dry and ready for the further steps of the operation.

Harrison Butler (*Ophthalmoscope,* Sept., 1911, from the *London Lancet,* Aug. 12, 1911) injects half a syringeful of codrenine, first under the skin, and then under and around the sac. He next makes an incision through the skin alone. He then draws an imaginary vertical line through the inner canthus, about 12 mm. long, and on this, using the canthus as a centre, makes with the knife a complete semi-

circle. This marks out a flap, which must be reflected outwards. It requires careful dissection to separate the skin from the internal palpebral ligament, for as it approaches the inner canthus, the latter becomes very superficial. Any carelessness will result in a buttonhole, which is a serious complication. Having reflected the flap, he passes a suture through it and gives it to a nurse to hold. He then passes another suture through the nasal lip of the wound, and gives that to a second assistant to hold. He is careful not to undermine the nasal lip, for on this side lie all the veins, and any indiscretion in that direction may cause troublesome bleeding.

The field of operation is now fully displayed by a very small incision, and no retractors (the use of which he believes increases the hemorrhage) are necessary.

The next stage is to dissect out and to define the ligament. This is done by a few strokes of the knife, which must always be made from the nose outwards to avoid wounding any small venules. A silk thread is now passed under the tendon and the nurse must draw it downwards. The fibres of the orbicularis muscle arise from the palpebral ligament, and have been dissected away with the superficial fascia. Some fibres seem to lie under the ligament; these must be pressed outwards and inwards by blunt dissection, and the deep fascia is then exposed. The palpebral ligament is a specialized portion of the deep fascia, but at its outer aspect it leaves the deep fascia and becomes superficial.

The deep fascia must be split vertically with knife or scissors and the sac exposed. We are now below all the veins, and the sac can be freed from its attachments above with the knife and seized with a pair of tenaculum forceps, and separated from the lacrimal fossa with squint scissors whose points must be constantly kept close to the bone. This dissection, which removes the periosteum as well as the sac, must be continued down to the palpebral ligament. Now getting the nurse to make tension on the skin flap, with the knife we dissect the sac away from the fascia which limits the orbit, and generally isolate the whole upper half of the sac. The next step is to pass the thread under the palpebral ligament, and have the ligament drawn upwards by its suture. Now both canaliculi are divided and the sac is dissected free down to the duct with scissors. When it is quite free, twist it round and round, to separate the duct from its bony surroundings, and cut it off with scissors as low down as possible. Then unite the skin wound by three horsehair sutures and firmly bandage a ball of wool sewn up in gauze into the hollow between nose and eye, so that the cavity may be obliterated. The dressings must be renewed frequently to keep up the pressure. The sutures are removed on the fourth day.

The wound almost invariably heals by first intention, and in a few weeks, becomes almost invisible.

Barck (*Oph. Year-Book,* p. 328, 1912) begins his operation with an incision mesially to the insertion of the internal palpebral ligament, directly down to the bone. The lacrimal sac is detached from the bone by curved elevators, and loosened all around by a curved hook. It is then severed at the entrance into the nasal duct. Then it is forcibly drawn down and out and the excision completed. Finally the nasal duct is curetted as far down as possible. The writer claims for his method that extirpation of the lacrimal sac has lost much of its unpleasantness. By former methods where the cupola was dissected while the sac was *in situ,* the work had to be done in the dark and portions were readily left behind in which case suppuration did not entirely cease. Hemorrhage was another unpleasant feature. By severing the lower end first and drawing the sac out of its cavity the cupola can be removed completely as the field is always open to view; hemorrhage is reduced to a minimum on account of the stretching and because the cutting can be done close to the walls of the sac. To secure union by first intention it is necessary to bring the soft tissues into close contact with the bone and to prevent accumulation of secretion between them; this is done by packing tightly. General anesthesia is preferred.

R. H. Elliot (*Brit. Med. Journal,* Nov. 1, 1913) does not believe it necessary to outline the sac by paraffin injections. The guide throughout the operation is the anterior lip of the lacrimal fossa. The internal palpebral ligament is first defined by pulling the lid outward. This ligament should never be divided. He cuts down on the anterior lip of the fossa, following its course with a crescentic incision 20 mm. long, which runs first downward and later downward and outward. He then inserts a Mueller's retractor, defines the fascia and divides it throughout the length of the skin incision, taking great care to cut this membrane as close to the crest as possible. With a sharp elevator the sac is separated from its bony bed internally and posteriorly; if not adherent, it may also be cleared with the elevator on the outer side, up to the point of entrance of the canaliculi into it. The dome of the sac is next seized with forceps and drawn firmly downward, while a pair of fine, blunt-pointed scissors is used to free it from its upper attachment, working under the palpebral ligament. The scissor points next divide the canaliculi and follow the sac down into the nasal duct. The duct is divided as low as possible and a large probe is then thrust down the duct as far as it will go and followed by a red-hot spindle-shaped cautery, thus destroying the mucous membrane.

Sequels of lacrimal sac excision. In addition to what has already been said on this subject attention is especially drawn to the occurrence of *post-operative epiphora.* Drainage through the duct having been cut off, the tears collect in the conjunctival sac and overflow onto the cheek. After the lapse of a few weeks or months the glands cease to secrete, to a certain extent, and finally provide moisture enough only to protect the cornea. If, however, a part of the mucous lining of the sac or the canaliculi has been retained, no alleviation of the epiphora may be expected unless the cause is ascertained and a second operation is successful.

To relieve the epiphora following removal of the sac, Fricker extirpates the palpebral gland by a special method: the upper lid being everted, a needle armed with a pretty stout thread is passed from below upward through the tarsus, slightly to the inner side of its center, 2 to 5 mm. from the upper free margin, while the patient directs the eye downward and inward; this maneuver brings the palpebral gland, in toto, to view. After subconjunctival injection of eusemin, the conjunctiva covering the gland is divided with a Graefe knife, the gland laid bare, grasped with forceps and excised with a small curved scissors. A conjunctival suture is not required.

Mattice (*Klin. Monatsbl. f. Augenheilk.*, July, 1912) examined one hundred patients from whom a tear sac had been removed, and found pneumococci in 43 per cent. of the conjunctival sacs on both sides, whether one or both sacs had been removed. These pneumococci showed a mild degree of virulence for white mice, and the virulence increased on passage through animals. He discovered no connection between the degree of epiphora and the bacteriologic content of the conjunctival sac, and believes that the appearance of the conjunctiva, whether pale or injected, is no criterion of the presence or absence of pneumococci. He could not confirm the statement of Calderara, that removal of the tear gland synchronously with extirpation of tear passages increases the danger of corneal infection.

The investigations showed conclusively that the removal of the tear sac in cases of dacryocystitis is an extremely important prophylactic measure against post-operative corneal infection, since pneumococci, the usual cause of such infection, are reduced from 90 per cent. to 95 per cent. before, to 43 per cent. after, extirpation, or to an amount and virulence often found in normal conjunctival sacs.

Zimmerman (*Woch. f. Therap. u. Hyg. des Auges.*, Vol. 16, p. 306) has devised a silver plate to occupy the site of an extirpated lacrimal sac, i. e., a *lacrimal prothesis.* It contains a small opening through

which a probe may be entered and passed down into the duct when the latter becomes occluded by blood or mucus.

Takashima (*Klin. Mon. f. Augenheilk.,* 51, p. 338, March, 1913) details a case long under treatment for conjunctivitis. As this was unsuccessful and a marginal opacity of one cornea developed, both lacrimal sacs were extirpated. The next day an abscess of the right lid formed with gangrene. This was followed by multiple abscesses in the scalp and temple, and in spite of large incisions pleurisy set in, and the patient died four days after operation.

OPERATIONS ON THE NASO-LACRIMAL WALLS.

Dacryocystorhinostomy. Toti's operation consists in resecting the crista lacrimalis, the lacrimal bone, the floor of the lacrimal sac and a corresponding piece of nasal muco-periosteum. It is designed to secure a broad communication between the sac cavity and the nose by resection of the nasal wall of the sac and the surrounding bone and mucous membrane. This procedure, as well as similar operations of West, Cirincione and others, is fully described on p. 3723, Vol. V, and p. 1917, Vol. III, of this *Encyclopedia.*

A number of operations modifying these original methods and not described in the pages mentioned will be briefly reviewed here.

Prince's operation for draining the sac into middle meatus, begins with local anesthesia to the sac and to the corresponding area in the nose. The subsequent steps are as follows: opening the punctum and passing a canaliculus knife into the sac; passing a lacrimal grooved director through the sac into the nasal canal; slitting the canaliculus and passing the largest possible lacrimal probe; passing a gouge 4 mm. wide to the bottom of the sac. By pressing toward the nose it will enter the middle meatus and may be readily seen from below.

The gouge is now removed and a strip of sheet lead 30 mm. long, 4 mm. wide, 1 mm. thick, is introduced, with the point slightly tapered. While observing the end of the plate through the nose withdraw it until it almost disappears, when it will be found that the nasal wall of the sac, together with the corresponding portion of the lacrimal bone, will rest in the extremity of the lead plate. By grasping the end of this by an appropriate forceps one will be able to remove the inner wall of the sac, the thin lacrimal bone and the end of the strip of lead at the same time, and thus establish permanent drainage.

Graham and Patton (*Ophthalmoscope,* Nov., 1914) describe the following operation, which consists of removal of a small circular piece of mucous membrane from the outer wall of the nostril opposite the

anterior end of the middle turbinal, a rectangular flap of membrane, including this hole, is then turned backwards and upwards, and the bone forming the inner wall of the tear-sac is chiselled away. A probe is passed into the tear-sac through the lower canaliculus and pushes the wall of the sac through the bony opening. This bulge is then snipped away. When the flap of nasal mucous membrane is put back into position, the holes in the sac-wall, the bone, and the nasal membrane coincide. A strand of strong gut or a piece of thin lead wire is passed from the lower canaliculus through the new passage and out of the nose to help to keep the flaps in position and opposite one another while healing takes place. The nose is plugged for the first two or three days.

Giant Ectasia of the Lacrimal Sac.
Before operation. (Sydney Stephenson.)

Polyak (*Ophthalmoscope,* June, 1915) modifies an earlier operation thus: After anesthetizing the nasal mucous membrane with cocain and a sub-periosteal injection of ''novocain-tonogen'' he forms a mucous membrane flap in the lateral nasal wall in the middle meatus. This flap is folded back, the bony wall of the lacrimal groove is removed with chisel and punch until the whole nasal wall of the sac is exposed. The nasal wall of the sac is then removed completely, being especially careful that that part where the sac passes into the nasal duct is removed, for here there is apt to be a small pocket in which septic material may lodge after replacing the flap. The nasal fossa is tamponned for three or four days. When the result, after two months, is satisfactory, it may be considered as permanent. In about 15 per cent. of cases complications occur. The opening closes or synechia forms between the lateral wall and the septum.

The results are good in all forms of dacryocystitis, but are best and most easily obtained when there is ectasia of the sac.

J. A. Pratt (*Ophthal. Record,* April, 1915) makes an incision into the sac, starting at the upper canaliculus. A dental burr is now introduced and a hole bored into the nasal cavity.

He also describes another operation with the object of establishing drainage into the nose in cases in which the sac has been removed. The opening is made with the burr, and a strip of mucous membrane from the lower conjunctival sac is pulled through and anchored to the outside of the nose.

Ectasia of the sac, dacryocele or *mucocele*, is a distention due to a collection within the sac walls of tears, mucus, pus, or other foreign material. When the affection is limited to the sac, it may be extirpated. Occasionally the removal of a coincident obstruction to the drainage system of the eye may bring about improvement or cure.

Giant Ectasia of the Lacrimal Sac.
After operation. (Sydney Stephenson.)

Argyrosis of the lacrimal sac. Permanent staining of the sac may occur from the local use of most silver salts (especially of argyrol and protargol) when employed in the presence of abrasion of its mucous lining. E. von Skramlik (*Klin. Monatsbl. f. Augenheilk.*, 54, p. 443, 1916) reports the case of a woman, aged 59, who instilled a 1 per cent solution of *argentum colloidale* into the right eye for seven months; in the first three weeks daily, and then occasionally. There was a marginal, torpid ulcer of the cornea, intense greyish-violet discoloration of the whole conjunctiva, and blennorrhea of the lacrimal sac. A probe could not be introduced into the duct. The tear-sac was extirpated. The microscopic examination showed the typical picture of chronic dacryocystitis and changes caused by the deposit of silver. These were of two kinds: a diffuse light-brown coloration of the subepithelial fibers of connective tissues and numerous grey or black, more or less fine granules, almost exclusively intracellular or on the elastic fibers in the subepithelial and deeper portions of the wall. Apparently a final product (metallic silver) is deposited in the tissues. See, also, **Argyrosis oculi**; and **Argyrol.**

Lacrimal tuberculosis is not so rare as it was at one time supposed to

be. The disease appears under the influence of various causes, predisposing and determining. Among the former are heredity, stigmata of latent tuberculosis, as "scrofula," or active surgical tuberculosis, as adenitis, lupus, or osteoarthritis. Predisposing factors are also the female sex (74 per cent. of the cases) and early adult life (average 19 years; average of ordinary dacryocystitis, 37 years). Primary lacrimal tuberculosis evolves without lesions of contiguous parts, and may be met with in healthy subjects, in the "strumous," and, more rarely, in the phthisical. It is due to exogenous infection. Secondary lacrimal tuberculosis, on the contrary, succeeds a primitive focus of disease in the nasal cavities (which should always be looked for), a cutaneous lupus, and comparatively seldom a conjunctival or osseous lesion. It is due to an endogenous infection.

Both Rollet (*Ophthalmoscope,* Oct., 1911) and Bribak (*Klin. Monatsbl. f. Augenheilk.,* p. 747, Dec., 1911) have carefully investigated lacrimal tuberculosis. Four principal classes may be recognized: A. The fungating lacrimal tumor, the so-called "lacrimal white swelling," i. e., a doughy, non-reducible prominence of the lacrimal sac, not associated with the escape of pus upon pressure. The overlying skin shows no changes. This is a non-suppurating and closed form of tuberculosis. B. A simple escape of tears, due to hyper-secretion at the beginning or to obstruction by tiny fungating growths of the lacrimal sac or nasal canal. C. Lacrimal suppuration—chronic dacryocystitis—without at first ectasia of the sac. This may be followed by a lacrimal tumor. D. Tuberculosis of the neighboring structures, affecting especially the presaccular connective tissue. Tuberculosis fistula of the sac and ostitis are included in this class.

The microscopical appearances include follicular lesions, situated particularly in the sub-mucous adenoid layer. The subcutaneous tissues may be invaded by epitheloid and giant cells. Sclerosis of the lacrimal sac is common. The specific micro-organism is rarely to be found in the lacrimal fungosities.

Rollet insists upon the complete curability of the lesions. He points out, that a "scrofulous" subject has undergone a relative vaccination, and seldom develops visceral complications.

The clinical *diagnosis* is often simple enough, and may be made by the association of signs, such as the age and sex of the patient, the family history of tubercle, the possibility of infection, and the associated stigmata. The softness of the fungous swelling, and the enlargement of the neighboring glands, together with the chronicity of the affection, attract attention, to say nothing of a fistula, caseous clots, and violaceous skin, should such be present. By these means it becomes

possible to exclude pure inflammatory lesions, syphilis, and sporotrichosis. Laboratory methods may be usefully employed in diagnosis, more particularly as histological examination is in itself inadequate, since nodular formations and giant cells are not peculiar to tuberculosis, and side by side with a specific follicular tuberculosis there may exist an inflammatory or non-follicular tuberculosis. Other plans that may be adopted include the finding of the Koch bacilli in the lacrimal pus and especially in pus from the enlarged glands (Poulard), the subcutaneous inoculation of the guinea-pig, the use of tuberculin, and the agglutinating sero-reaction.

Apart from tuberculin-therapy it may be said that the *treatment of lacrimal tuberculosis* is essentially surgical and local. Lavage has its indications in early cases, although cure is seldom reached by that means. Probes may be employed in certain non-fungating forms of the disease, but Rollet does not recommend them very strongly. Neither does he wax enthusiastic over opening the diseased sac, and treating its contents with the curette or the thermo-cautery, or with such agents as lactic acid, gold chloride, bismuth paste, or xeroform. The best treatment, in his opinion, is to extirpate the affected sac. When dealing with diffuse fungous lesions, the sac must be destroyed with the thermo-cautery or removed piecemeal.

Diphtheria of the lacrimal sac is generally a complication of laryngeal, nasal or conjunctival diphtheria, and the treatment, by injection of diphtheria antitoxin, etc., forms part of the therapy employed in combatting the infection of the contiguous tissues.

Primary sporotrichosis of the lacrimal sac is a rare affection. The symptoms are epiphora, redness, swelling in the region of the *sac* and swelling of the preauricular and submaxillary glands. In the case described by Morax (*Ann. d'Oculist,* Jan., 1911) there was dacryocystitis, the formation of two subcutaneous nodules in the cheek and a prelacrimal abscess. Cultures from the pus of the last showed *Sporothrix beurmanni.* The condition was relieved by potassium iodide. See, also, p. 3058, Vol. IV of this *Encyclopedia;* as well as **Sporotrichosis of the eye.**

Trachoma of the lacrimal passages is uniformly an extension from the conjunctival sac. Marougin found women more susceptible than men to this form of inflammation of the sac. Extirpation is the ideal treatment. See, also, **Trachoma.**

Neoplasms of the lacrimal sac are not common. Bistis (*Trans. Eleventh Inter. Med. Congress,* April, 1909) reports a case of *primary cancer of the sac* in a seaman of 60 years. The tumor was the size of a hazelnut and was encapsulated in a thickened and fibrous sac wall,

strands of which had grown into and through the mass. After removal, recurrence took place. *Sarcoma* is a rare affection. Sylvester (*Ann. di. Ottal.* XXVI 5, 452) reports a case in which the tumor sprung from the wall of the sac. Extirpation was followed by recurrence in the orbit and parotid region. *Epithelioma* is also rare. It appears as a swelling in the sac, involving the adjacent regions. Microscopically it consists of cylindrical cells derived from the epithelium of the mucous membrane. *Treatment* is by radium or X-ray after thorough extirpation. See, also, **Tumors of the eye.**

Polyp of the lacrimal sac. This exuberance from the mucous lining of the sac resembles similar growths in the nares. They are difficult of diagnosis until after extirpation of the sac. Tooke (*Archives of Oph.*, Sept., 1912) found this tumor twice in microscopic examination of fifty excised sacs. They gave evidence of hyperplastic growth or actual tumor formation which possibly may have been due to a preexisting inflammation, which is not necessarily of an infective or suppurative type. That glandular elements are not shown in the section is not surprising as Tooke has found but a single true gland in the mucosa, and in one case only. He calls attention to the fact that the passage of probes would not have been effective in these cases and that the primary etiological factor was not trauma, but rather a chronic thickening of the nasal mucosa. Two varieties have been studied, *sessile* and *true* polyp. The former are the result of hyperplasia of the mucosa exceeding that of the underlying papillæ, while the reverse process favors the development of the latter form. Both are due to chronic inflammation of the mucous membrane. A polyp consists of a loose meshwork of young connective tissue, somewhat infiltrated with mononuclear and polynuclear leucocytes, plasma, epitheloid cells and many capillary vessels. It generally fills the lumen of the sac, making a small, round, compressible tumor which prevents the passage of tears. It should be excised and its base cauterized.

Pseudo-polyp is a vegetation or outgrowth with a broad base, resembling or identical with the so-called true polyp.

Lacrimal cysts the size of a pea may arise from the mucous membrane and contain clear fluid or pus. They may or may not close the duct. They are accompanied by inflammation of the neighboring tissues. Santos Fernandez has described two of these, of which one was adherent to the wall of the upper left lacrimal duct of a man, and the other to the lower left lacrimal duct of a woman. In both of these instances water could be injected that penetrated to the throat and nasal fossa, without, however, going into the cyst. It was also pos-

sible to pass a silver thread through the duct, thus confirming its integrity, also made evident with Anel's syringe.

It was suspected, however, that the cyst had perforated the wall of the duct, through which perforation the cyst had become infected. On that supposition Fernandez dilated the lacrimal puncta. After the cyst had been emptied its contents were washed out and proved to be pus, a small quantity of a yellowish liquid and a substance of hard appearance which was not examined but which was thought to be sebaceous and not calcareous.

The swelling of the cyst in the first case was the size of a large pea and had lasted for 40 years, but it disappeared immediately after the operation. The second case had had the cyst for a short time only, but was free from it as soon as the lacrimal puncta were dilated.

Pneumocele of the lacrimal sac. In this condition the sac (or pneumocele) becomes blown out like a bellows at every full expiration and at every inspiration the tumor disappears. Elliot (*Indian Med. Gazette,* Nov., 1909) discovered its presence accidentally in two patients who were etherized preparatory to extirpation of the lacrimal sac. In one patient the sac became visibly distended with air during expiration with mouth and anterior nares closed. He noticed that if the sac was then pressed upon, the air passing down into the nose produced a distinct musical note. The obstruction above and the free, wide passage below appear to have determined this unusual condition.

Lacrimal blennorrhea of infants, or *congenital blennorrhea* is a mucous or semipurulent discharge due to a collection of débris or irritation therefrom, or delayed opening of the nasal extremity of the duct. The lower end of the duct is incomplete at birth or the duct itself is not completely patulous.

Dacryocystitis of the new-born generally disappears spontaneously. If it does not, expression of the contents of the sac and injection of zinc or argyrol solution during the first few months will usually effect a cure. See, also, p. 3721, Vol. V; as well as p. 2945, Vol. IV, of this *Encyclopedia.*

Peridacryocystitis, or prelacrimal abscess, is the result of an inflammation of the soft tissues adjacent to the anterior and lateral surfaces of the sac. As the disease progresses the inflammation may extend through the wall into the sac and it then becomes a phlegmonous dacryocystitis. In the early stages treatment is to be directed to the subsidence of the inflammation; later irrigation; dilation and possibly removal of the sac. See **Dacryocystitis phlegmonosa.**

Fistula of the lacrimal sac. Spontaeous opening of abscess of the

sac frequently leads to fistula through which tears and pus are discharged into the skin of the face.

Congenital fistula may be unilateral or bilateral, and symmetrical, and due to arrest of development, dacryocystitis or an epithelial outgrowth from the tear passages.

The canal becomes filled with granulation tissue and presents a number of small openings through the subcutaneous tissue and skin.

Should medicinal measures be unavailing, such as injecting tincture of iodine through the fistula into the sac, and exposing the fistula itself to the remedy, operation is indicated. The sac should be well opened, necrosed tissue removed either by knife or curet, drainage through the lacrimal canal re-established, or the sides may be freshened, cauterized and treated as an open wound, the fistula walls excised and the parts brought together by pressure. The fistula will remain open as long as the canal is occluded. See, also, p. 1387, Vol. II, of this *Encyclopedia,* as well as **Congenital anomalies.**

Wray (*Proc. Roy. Soc. Med., Sec. on Opthal.,* Nov., 5, 1913) operates on the fistula after injecting cocain and instilling a drop into the conjunctival sac. A Bowman's probe is then passed into the sac and the point pushed forward under the palpebral ligament. He cuts down on this guide, taking care to note the click of the knife on the probe. He then places crystals of novocain in the sac and has recourse to probing. A special style, so constructed that when a piece of strapping is placed on its arms it cannot move, is introduced. While it is *in situ* argyrol 5 per cent. is used three times a day. Later, when a firm-edged fistula has formed, the patient is instructed to irrigate the sac three times a day, passing the style at night and taking it out in the morning. To cure the fistula it may be dilated, and while stretched all the cicatricial tissue cut away, after which the edges of the wound are brought together and covered with collodion.

Caries of the lacrimal bone may result from traumatism or one of the systemic diseases, such as syphilis and tuberculosis.

The *treatment* consists of appropriate systemic remedies, combined with the curetting and extraction of necrosed bone, either from the nose or through the sac.—(H. F. H.)

Lacrimal conjunctivitis. A term employed by Galezowski to designate those cases of catarrhal conjunctivitis which are either caused or prolonged by the retention of tears in the cul-de-sac and on the conjunctiva. Its symptoms are those of catarrhal conjunctivitis with marked epiphora. After lacrimal drainage is established the disease slowly disappears.

Chronic conjunctivitis may also be a sequel of *ablation of the lacri-*

mal gland. See under **Lacrimal apparatus, Diseases of the.** A Trousseau (*Annales d'Oculist.*, Feb., 1909) believes that in most cases this is quite unimportant, but every now and then more serious cases are seen, in which the conjunctival secretion becomes purulent some 15 to 20 days after operation, and in which no known remedy seems to have a curative effect.

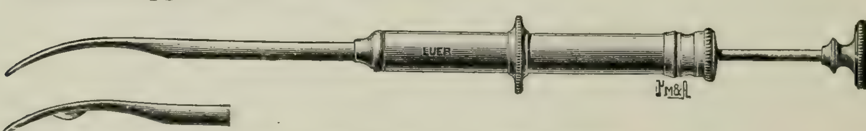
Trousseau records three of these latter cases which have come under his own observation. He suggests that the tears normally have a bactericidal action, and that this protection is taken away when the lacrimal gland is removed. In one case, however, lacrimation was present after the operation, and an examination of the secretion revealed no change from the normal. All operations on the lacrimal gland are not followed by conjunctivitis, and it is supposed that these symptoms only follow complete removal. The possibility of the section of important nerves during the operation must also be borne in mind. See, also, p. 3113, Vol. IV of this *Encyclopedia.*

Lacrimo-labialis. A superficial muscle of the solipeds, continuous with the super-nasolabialis in front, the cuticularis behind, and the orbicularis palpebrarum above. It corrugates the skin beneath the eye.

Lacrimo-nasal duct. See p. 351, Vol. I of this *Encyclopedia;* as well as **Histology of the eye**; and the major heading, **Lacrimal apparatus.**

Lacrimo-nasal duct, Obstruction of the. See **Lacrimal apparatus, Diseases of the.**

Lacrimotome. An instrument for incising strictures of the lacrimal passages. The name should, in fact, be applied only to the instrument of Giraud-Teulon (see the figure) in which a probe provided with a cutting end is combined with a lacrimal syringe. See, also, **Lacrimal apparatus, Diseases of the.**



The Lacrimotome of Giraud-Teulon.

Lacrimotomy. Incision of the lacrimal sac or duct.

Lacruma. (L.) A tear.

Lacrym—. For most English words so beginning (and for which spelling there is no good authority) see **Lacrim—.**

Lacryma. (L.) A tear.

Lacrymatome. LACRYMOTOME. See **Lacrimotome.**

Lacrymin. See **Dacryolin.**

Lactate of silver. See **Actol.**

Lactation, Ocular relations of. This important function occasionally

exhibits the apparent but often the merely coincident accompaniment of an ocular lesion or symptom. Parsons (*Pathology of the Eye,* p. 1307) enumerates conjunctivitis, phlyctenular ophthalmia, herpes corneæ, mydriasis, paresis of accommodation, choroiditis and complicated cataract, night-blindness, retinitis, optic neuritis, amblyopia, paresis of extrinsic muscles, etc.

Zani's (*Ann. di Ott.,* Vol. 42, p. 46, 1912) patient was a vigorous healthy woman of 25 years who had nursed four children. During lactation of the fifth child the abundance of milk was more marked than with previous children. When the baby was three months old the mother was attacked with violent headache and phosphenes. By the end of a week vision was reduced to finger counting. There was intense bilateral papillitis without hemorrhages or white spots. There was dull pain in the back of the orbit. All examinations and tests gave no etiological clue. Cessation of lactation was induced but no change in the eyes was noticed for twelve days, after which time the ocular conditions were gradually restored to normal.

Villard (*Wien. Med. Wocheschr.,* Feb. 1, 1913) records two instances of involvement of the optic nerve during lactation. The first was a woman 36 years of age. After the birth of the child, during the gestation of which she had typhoid symptoms, optic neuritis with hemorrhages developed. The fields were greatly contracted, and there was a central scotoma due to the macular extravasation. Six weeks later the optic nerve was normal in appearance, but there was pigment in and about the macula. In the second case, following a normal gestation and labor, the mother developed a unilateral neuritis. Five weeks later this had disappeared and atrophy had set in. Five weeks later vision and fields were nearly normal, but the optic nerve was still pale. *Treatment* should consist in weaning the baby, the use of sudorifics, diuretics and purgatives, local blood letting, subconjunctival injections of salt and a course of mercury. The *prognosis* is relatively favorable. The theories which have been advanced to explain the neuritis are: malnutrition, toxemia, vicarious congestion of the optic nerve through checking of the secretion of milk and finally auto-intoxication.

Lactic acid. See **Acid, Lactic.**

Lactin. Lactose, or sugar of milk.

Lactol. A colorless, tasteless powder, a lactic-acid ester of beta-naphthol, used as an intestinal antiseptic. Dose, 3½-8 gr. (0.25-0.5 gm.). Also, actol lactate, a silver preparation, used especially in gonorrhea of the eye. See p. 86, Vol. I of this *Encyclopedia.*

Lactometer. GALACTOMETER. LACTODENSIMETER. A simple instru-

ment for the optical estimating of the amount of cream in milk; it consists of a glass tube graduated to 100 parts. New milk is poured in and when the cream has completely separated the quantity is measured on the scale. Another form of instrument is a small hydrometer, indicating the density of the milk, by which the quality is judged. This method is however unreliable. See, also, **Galactoscope,** p. 5327, Vol. VII, of this *Encyclopedia.*

Lactopeptin. A proprietary digestant remedy of milk-sugar, 120 parts; pancreatin, 18 parts; peptone, 24 parts; lactic acid, 2 parts; hydrochloric acid, 2 parts; and diastase, 1½ parts. Dose, 5-15 gr. (0.333-1 gm.). Occasionally applied to false membranes on and about the eye.

Lactophenin. This white, crystalline powder is a derivative of phenetidin with lactic acid. It is slightly soluble in water and is recommended, in half to one gram doses, for headache, rheumatism, etc. Lewin and Guillery (*Giften auf das Auge,* II, p. 897) record a case in which twenty minutes after taking a half gram dose severe nervous symptoms, associated with misty vision, set in. Recovery occurred in less than an hour.

Lactoscope. An instrument for the optical measurement of the constituents of milk. See **Galactoscope.**

Lactrine. An opalescent glass used to soften the effect on the eyes of the electric light. See the London *Lancet,* p. 877, Nov. 18, 1882.

Lactucarium. Lettuce opium. This slightly narcotic drug is the inspissated juice of *Lactuca sativa* or *virosa.* It contains lactucin, hyoscyamin, etc., in minute quantities. In 100 cases where large doses were taken more than half of them exhibited dilated pupils.

Lactyltropin. This white, crystalline powder is soluble in water. It is used as a cardiac tonic and possesses weak mydriatic powers. A 10-20 per cent. solution, instilled into the eye, after half an hour causes a slight dilation of the pupil which increases *ad maximum* in two hours and persists for several hours more.

Lacunæ of the eye. These interspaces are sometimes physiogical, sometimes abnormal. For example, *the lacunæ of the cornea* are interspaces between the corneal laminæ and bundles of the cornea, and are entirely normal.

Of the same character, also, are the *lacunæ of the crystalline lens*—physiologic spaces supposed by some writers to exist between the lenticular fibres.

On the other hand, Schnabel's cavernæ—see Vol. III, p. 1794 of this *Encyclopedia*—are lacunar spaces generally due to a glaucomatous process.

The so-called *lacunæ in the optic* nerve, observed by other writers,

are probably also of the same character. For instance Haist (*Tübingen Thesis*, 1913) examined four eyes with myopia without complications which could have given rise to glaucoma, with especial reference to the presence of lacunæ in the optic nerve. In all, vacuoles, which had great similarity to those described by Schnabel in glaucoma, were found. These were present only in the anterior section of the nerve between and behind the lamina. There was associated simple partial optic atrophy with thickening of the septa and in places loss of the medullary sheath. Wagenhaüser (*Woch. f. Therap. u. Hyg. d. Auges.*, Vol. 16, p. 372, 1912) gives the anatomical changes found in the optic nerve in eight cases of luxation of the crystalline lens by trauma. In all but one there was secondary glaucoma with glaucomatous excavation of the disk. In four of the seven vacuoles were found in the optic nerve. From the histories of the cases it would seem that vacuoles are not found where glaucoma has been long existent. Rados (*Klin. M. f. Augenh.*, p. 355, Sept., 1913) has sectioned two eyes showing cavernous degeneration of the optic nerve. The first eye was removed for inflammatory glaucoma. Microscopically there was a thrombus of the central vein which led to secondary glaucoma. The thrombus was of long standing. There was no typical glaucomatous excavation. In the second case there was a thrombus behind the lamina cribrosa which had organized. There were extensive changes in the retinal veins and to a lesser extent in the arteries; in part due to obstruction. These changes had given rise to secondary glaucoma with the formation of a typical, kettle-formed excavation and cavernous degeneration of the optic nerve stem on the lateral side of the excavation.

Lacunule. A small lacuna.

Lacus lacrimalis. LACUS LACRIMARUM. The small space at the inner canthus of the lids towards which the tears flow, and at which the triangular canal formed between the closed lids terminates. See **Lacrimal apparatus**; **Anatomy of the eye**; as well as **Histology of the eye.**

Ladd-Franklin color theory. See Vol. IV, p. 2493 of this *Encyclopedia.*

Ladled glass. Broken crown-glass intended for remelting.

Lævophoria. LEVOPHORIA. See **Heterophoria.**

Lævoversion. LEVOVERSION. See **Heterophoria.**

Lage. (G.) Layer; posture.

Lagenaria vulgaris. The calabash, bottle-gourd, or white pumpkin; a native of tropical Asia and Africa, cultivated in other warm countries. The pulp of the fruit is bitter and somewhat laxative and may be substituted for colocynth. In the West Indies it is used as a poultice for inflamed eyes.

Lageverkehrung. (G.) Inversion.

Lagophthalmia. Lagophthalmos. Lagophthalmus. Inability to close the eyelids. The form, at one time, called lagophthalmos paralyticus, is due to paralysis of the orbicular muscle of the eyelids, the result of partial or complete paralysis of the facial nerve. The patient is unable to close the eyelids, either in whole or in part, the interpalbebral aperture seems wider than normal, and the eye has a staring appearance.

The most common result of inability to close the eye consequent on this condition is the so-called *keratitis e lagophthalmo.* It is found in paralysis of the orbicularis muscle; in persons suffering with profound exhaustion (typhoid fever, uremic coma, etc.); in cases of destruction or cicatricial contraction of the eyelids; in caries of the orbital margin, producing ectropion; and, rarely, in exophthalmic goitre when the exophthalmos is excessive. As a result of desiccation the cornea becomes fissured, and pathogenic germs, gaining a foothold, soon cause suppurative inflammation. Hypopyon, iritis, and extensive ulceration of the cornea are common, while perforation and total loss of the eye are not rare. The corneal ulcer is distinguished by its location at the lower edge of the cornea, by its sharply divided upper edge parallel to the margin of the upper lid, and, finally, by the fact that a dry scale is first produced, the ulcer not being visible until the scale is thrown off. The general course of the disease resembles that of neuroparalytic keratitis. The prognosis is serious, and particularly is it grave in the corneal ulceration of exophthalmic goitre.

Treatment. If possible, the cause should be removed. The cornea must be protected, and, in case a bandage does not suffice, the operation of uniting the eyelids (tarsorrhaphy) will be in order. It is customary to make a partial union of the eyelids, the outer portion being usually selected for operative intervention, although it may be deemed advisable to unite the middle third of the lids.

While the operation of partial tarsorrhaphy has generally been regarded as harmless, in cases of exophthalmic goitre it has sometimes been followed by disastrous results. Jessup says: "I should hesitate to again employ it in such cases, or at all events in a patient over thirty-five years old. As soon as the cornea was affected in my case, no treatment seemed to have the slightest effect in staying the ulceration." In milder forms of lagophthalmic keratitis the affected eye should be bandaged at night. Atropin and mild antiseptic washes are to be used and all sources of irritation are to be avoided.—(J. M. B.)

See, also, **Tarsorrhaphy**; as well as **Keratitis e lagophthalmo.**

Lagottalmo. (It.) Lagophthalmos.

Lagrange operation. See p. 5513, Vol. VII, of this *Encyclopedia.*

Lagrimale. (It.) Lacrimal.

La grippe, Eye affections due to. See **Influenza.**

Lähmung. (G.) Paralysis.

Lahore sore. An eruptive endemic, occurring chiefly in Asia and Africa, marked by the development on the face of a papule which passes successively through the stages of tubercle, scab, and circumscribed ulcer. It is thought to be caused by a protozoan parasite, termed *Helcosoma tropicum* or *Leishmania tropica vel furunculosa.* The disease has received various names, according to the locality of its occurrence, as Aleppo button or boil, Delhi sore, Pendjeh sore, Natal boil, Biskra button, Lahore sore, etc., but the conditions occurring under the various names are practically one and the same disease. See p. 217, Vol. I of this *Encyclopedia.*

Laifan. A Chinese neuralgia remedy: said to be crude Blumea camphor.

Laine philosophique. (F.) Zinc oxide.

Laines et crayons colorés. (F.) Colored wools and pencils.

Laiose. Leo's sugar. This is a pale-yellow syrup, found in the urine of diabetics. It is non-fermentable and levorotatory.

Lallemand, Claude-François. A celebrated Monspellensian surgeon and genito-urinary specialist, of some importance in ophthalmology. Born at Metz, Jan. 26, 1790, he received his medical degree at Paris in 1819, and at once was appointed to the chair of surgery at Montpellier. His most important writing, and that which rendered him famous was "*Observations sur les Maladies des Organes Génito-Urinaires*" (2 parts, Paris and Montpellier, 1825-27) of which there were numerous editions and translations. He was a distinguished operator, and became, in course of time, by far the most celebrated surgeon in southern France. In the above-mentioned work he discussed the ocular disturbances dependent on undue seminal losses, and he also wrote an article on the formation of the artificial pupil.

In 1845 he removed to Paris, and there remained in philosophic retirement until his death, July 23, 1853.—(T. H. S.)

Lalophobia. A term applied by Schultheiss to stuttering, the stutter-spasm being considered as of the same nature as in photophobia and hydrophobia.

Lamarck's theory. The theory that acquired characteristics may be transmitted.

Lambeau. (F.) A surgical flap.

Lambent. Running along or over a surface, as if in the act of licking; gleaming.

Lambert, Antoine. A 17th century surgeon of Marseilles, who devoted

considerable attention to ophthalmology. Born at Luc, Provence, he was a self-made man, his only instructor having been ''a master surgeon at Marseilles,'' who taught him to shave, to bleed and to cup. Settling at Marseilles, he was esteemed especially as an operator on the eye.

In his ''Les Commentaires et les Oeuvres Chirurgicales d'Antoine Lambert, natif du Luc, Maitre Chirurgien á Marseille, Divisé a Cinq Partics'' (Marseilles, 1662; 2d ed., Lyons, 1671; 3d ed., Marseilles, 1677) a chapter is devoted to his treatment of fistula lachrymalis, as follows: ''Having opened the fistula with the scissors and hollow sound, and having thoroughly explored with a slender probe, which is a trifle curved, the dilated orifice and the open sinus both above and below, we take a little plug,* proportioned to the length and width of the fistula, which we fill from its point to its middle with the ointment composed of two parts of the white of Rhazes and one of sublimate made into a powder. One fastens to the plug a thread, of which a certain part should be allowed to hang outside the fistula, for the purpose of enabling the plug to be withdrawn more easily, after its action is finished. The plug having been passed to the bottom of the sinus, is set chiefly under and against the glans [caruncle] between the eye and the orbit, where callous flesh is gathered together.''

The plug is left in place from 8 to 12 hours; and if, after the fall of the eschar (for the ointment in question was very escharotic) the process could be resorted to as often as might be necessary.

The treatment was so painful that the lids swelled enormously (they could not be opened for two or three days), and ''vomiting and cardialgias'' were also produced.

If, after the eschar had been removed, the bone was discovered to be carious, then it was touched a number of times with aquafortis or the spirit of vitriol or of sulphur, which was placed in the bottom of the sinus, by means of a pledget of cotton fastened to the end of a sound by twisting. If this did not suffice, Lambert employed what he called *siringation*—i. e., lavage with a solution composed of 2½ oz. of alcohol and an equal quantity of *eau de chaux* in which had been dissolved 4 or 5 grains of sublimate.

When, however, the caries was deep, the actual cautery was employed.—(T. H. S.)

Lambert, Johann Heinrich. (1728-77.) A German philosopher and mathematician, who was born at Mülhausen in Upper Alsace. In 1764 Frederick the Great made him a member both of the Council of

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* So I translate ''tante,'' which, in Godefroy's ''Lexique de L'Ancien Français,'' is defined ''appareil chirurgical''—a definition so vague as to be useless.

Architecture and of the Academy of Sciences. Lambert was the first to formulate (in his *"Photometria"*) a scientific basis for the measurement of light. He wrote several other scientific and philosophical works.

Lambert's law. Lambert found that the amount of light which passed through a colored filter or glass plate, diminished in geometrical progression as the thickness increased in arithmetical progression.

Lame. (F.) Lamina; blade of scissors, knife, etc.

Lamella iridis anterior. (L.) The anterior layer of the iris.

Lamellæ. See **Gelatine,** p. 5348, Vol. VII of this *Encyclopedia.*

Lamella, Posterior limiting. Membrane of Bruch. See **Histology of the eye,** under **Choroid,** also **Lamina vitrea,** *infra.*

Lamellar cataract. LAMINAR CATARACT. LAMINATED CATARACT. An opacity of the lens, partial in character, involving one or more zones or laminæ of the lens between the nucleus and the capsule, the remainder of the lens being transparent. It is generally congenital or formed a few months after birth. It is often stationary for years. See p. 1556, Vol. III of this *Encyclopedia.*

Lamellarly. In the form of laminæ.

Lamellate. LAMELLATED. LAMELLIFORM. LAMINIFORM. LAMINOSE. LAMELLIFEROUS. LAMINIFEROUS. LAMELLOSE. Consisting of a lamina or of laminæ.

Lamella, Vitreous. Bruch's membrane; the inner layer of the choroid.

Lamels, gelatine. OPHTHALMIC DISCS. Gelatine discs for ophthalmic purposes were first made for and used by Ernest Hart (the celebrated editor of the *British Medical Journal*) at St. Mary's Hospital, London, in 1863. They are very useful excipients for local ocular remedies, especially for homatropin, cocain, hyoscin, atropia, etc. See **Discs, Ophthalmic**; as well as **Gelatine.**

Lamina basalis. Vitreous layer of the choroid.

Lamina, Bowman's. The uppermost layer of the corneal stroma.

Lamina ciliaris retinæ. Zonula of Zinn.

Lamina choriocapillaris. A layer of fine choroidal capillaries supported by an almost homogeneous, non-nucleated stroma. It constitutes one of the chief laminæ of the choroid. See **Anatomy of the eye**; and **Histology of the eye.**

Lamina cribrosa. See **Histology of the eye.**

Lamina elastica anterior. BOWMAN'S LAYER. An important layer of the cornea. See **Histology of the eye.**

Lamina elastica posterior. Descemet's membrane.

Lamina fusca. One of the layers of the sclera. See pp. 373 and 374, Vol. I of this *Encyclopedia.*

Lamina iridopupillaris. For the fetal tissue commonly referred to as the anterior fibro-vascular sheath of the lens, or pupillary membrane, Collins (*Trans. Ophth. Soc. Unit. King.*, V. 33, p. 173) prefers the term *lamina iridopupillaris,* because the vessels of which it is principally composed extend over the anterior surface of the iris, as well as across the pupil and the anterior surface of the lens. He describes several instances of persistence of this structure in the form of fibrous tissue on the anterior surface of the iris. The tissue was sometimes traversed by a number of blood-vessels, whose formation Collins explains as possibly due to the re-establishment of obliterated fetal vascular channels as the result of intra-ocular congestion. See **Development of the eye.**

Lamina of Sattler. One of the layers of the choroid.

Lamina suprachoroidea. A delicate layer of connective tissue interposed between the sclera and choroid coat. See also **Lamina fusca.**

Lamina vasculosa. The outer part of the choroid, which contains the largest vessels.

Lamina vitrea. Membrane of Bruch. One of the layers of the choroid. See **Anatomy of the eye**; also p. 5958, Vol. VIII of this *Encyclopedia.*

Lamoptes. (L.) (Obs.) Blear-eyed.

Lamorier, Louis. Born at Montpellier in 1696, he studied surgery from 1718-20 under Méry at the Hôtel Dieu, Paris. Returning at once to Montpellier, he became successively professor at the School of Surgery, surgeon to the Hospital of Saint-Eloi and Fellow of the Royal Society of Sciences. He died in 1777.

He wrote no books, but a number of excellent articles from his pen are to be found in the *Memoirs of the Royal Society of Sciences* and in the Royal Academy of Surgery at Paris.

In 1729 he published in the Memoirs of the latter-named society a paper entitled: "A New Method of Operation for Lachrymal Fistula." His method consisted essentially in perforation of the lacrimal bone—a procedure neither new nor useful—though it has been proposed once more, as both, in this, the 20th century.—(T. H. S.)

Lamp. A contrivance in which is utilized the illuminating power of fluid, light-giving material. Specimens obtained from the excavations of the ruins of Tarsus, Pompeii, and Herculaneum and from other sources, show that they were made in considerable variety. A very primitive form of lamp, called a "crusie," was in use in Scotland until mineral oils were introduced by James Young about 1850. Animal fats and fish oils were the principal substances used in all parts of the world for burning in lamps until vegetable oils were introduced—viz., colza or rape and other seed oils and nut oils of various

kinds. In 1784 Aimé Argand introduced round cylindrical burners and round burners, whether for oil or gas, still known by his name as Argand burners.

In the use of fatty oils, the ordinary capillary attraction of the wick was insufficient to maintain a uniform flow of oil to the flame, and various contrivances were used to keep the oil as nearly as possible at one level. In 1803 M. Carcel introduced an excellent mechanical method of forcing the oil up by means of clockwork. This lamp, however, was too easily disarranged, and too expensive to come into general use. It was not till 1836 that Franchot invented his lamp, known as the "French Moderator."

Mineral lamp oils are known under various names, such as petroleum, kerosene, paraffin, crystal oils, etc., for the lighter sorts; and for the heavier or specially high list kinds such names as mineral sperm or mineral colza are used.

Previous to the introduction of mineral oils camphine, which is a volatile hydrocarbon spirit distilled from turpentine, was burned in Young's "Vesta" lamp, introduced in 1834. The common flat-wick paraffin lamps now so familiar to every one were first made by Stobwasser in Berlin. Since then the manufacture of paraffin lamps has grown to be an industry of great importance and is carried on largely in the United States, England and Germany.

Mineral lamps are made with flat wicks and with circular wicks. In the circular or Argand form of lamp the body of the lamp or oil container is made of glassware or metal, mounted on a pedestal. The outward casing of the burner is made of brass perforated for the admission of air. In the center of the burner the wick-tube or holder is inserted. Over the wick-tube in flat-wick burners a metal dome is placed to deflect the air into the flame. Across the dome there is a slit or oblong opening for the flame to pass through and a chimney eight or ten inches high, resting on a gallery at the base of the dome, creates the current of air necessary to perfect combustion of the oil.

Flat-wick burners have the advantage of being more easily trimmed and the flame more easily controlled than round burners. They admit also of a better supply of oxygen to all parts of the flame than has been possible with ordinary round burners, and in consequence less liable to smoke. In 1865 Messrs. Hinks of Birmingham, England, introduced the Duplex lamp with two parallel wicks and two openings in the dome producing two flames. This form of lamp rapidly became very popular and still deservedly continues so. Captain Doty in 1868 patented a lighthouse lamp for burning mineral oils, and in

1874 he patented his Triplex lamp, with three flat wicks arranged in the form of a triangle.

For temporary night-work out-of-doors some kind of spray and vapor lamp is used. In one form crude oil is stored in a strong iron cylinder, and by forcing air into the space above the oil, the latter is driven up a pipe to the burner. Here it passes through heated tubes, escapes from a jet partly as spray and partly as vapor, and burns with a rough and roaring but brilliant flame. Plumbers and painters use a lamp designed on a similar principle, but the jet of vapor is mixed with air and burns with a non-luminous flame.

For indoor lighting lamps may be divided into two classes. In the one the light is due to the presence in the flame of finely divided particles of carbon resulting from the decomposition of hydrocarbons, as in the benzene and naphtha lamps. In the other class the flame is on the Bunsen principle and non-luminous, but heats up to incandescence a mantle containing refractory oxides. For lamps of this latter class alcohol, light petroleum spirit and gasolene may be employed. The use of kerosene vapor to ignite a mantle has also been tried.—*(Standard Encyclopedia.)* See, also, **Illumination**; as well as **Lamps, Ophthalmic.**

Lampada. (It.) Lamp.

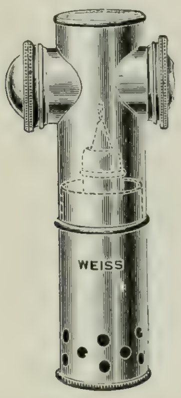
Lampblack. The soot or amorphous carbon obtained by burning bodies rich in that element, such as resin, petroleum and tar, or some of the cheap, oily products obtained from it. The supply of air is limited or controlled so as to produce a smoky flame, and the smoke passes into a chamber with some arrangement for receiving the abundant deposit of soot. Lampblack is a useful pigment for artists both in oil and water color, a coarser kind being employed by house-painters. Very fine grades form the coloring matter in Indian ink, coarser qualities being mixed with boiled linseed oil to make printing-ink.—*(Standard Encyclopedia.)*

Lamp, Operation. See **Lamps, Ophthalmic.**

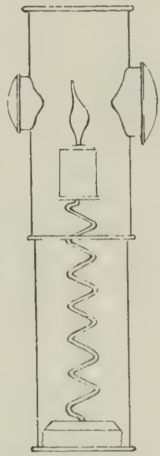
Lamps, Ophthalmic. These illuminating devices are of special value to the ophthalmic surgeon not only in the examination of patients but for operative purposes. They have, to some extent, been pictured and described under a number of appropriate rubrics, such as **Lamp**; **Handlamp**; **Examination of the eye**; as well as under **Diaphanoscopy**; **Illumination**; and **Hospitals, Ophthalmic.** See, also, p. 6168, Vol. VIII of this *Encyclopedia.* To the information furnished in these sections is now presented a short account of a few additional lamps—electric and other.

The useful ward lamp of Priestley Smith has been referred to

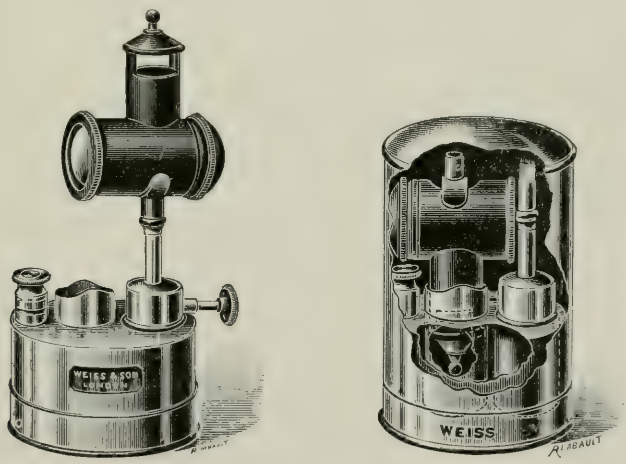
under **Examination of the eye.** The cuts in this section show its method of employment.



Priestley Smith's Candle Ophthalmic Lamp.


Sectional View.

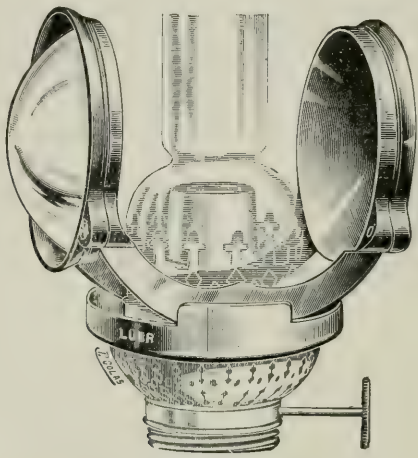
Weiss' portable ophthalmic lamp (see figure) contains a sponge saturated with benzoline, the supply of the latter being carried in a reservoir which forms part of the base of the lamp.



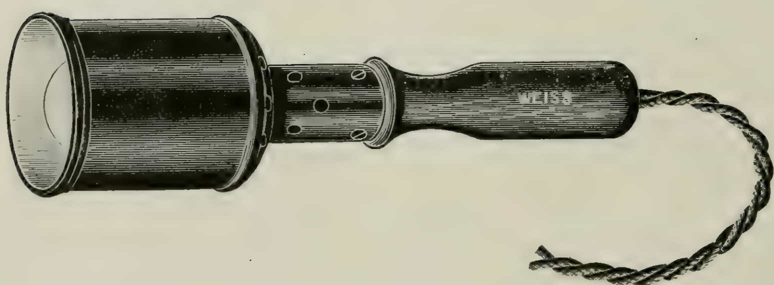
Weiss' Portable Ophthalmic Lamp.

Luer's lamp (*phare articulé*) carries a movable reflector and converging lens fitted for either gas or oil. See the figure.

The portable electric light lamp and stand (modified from other well-known models) used in the Illinois Eye and Ear Infirmary can be placed where it is needed and in such a way that the stand proper is not in the way of the operator, assistants or spectators. It is principally intended for use in the eye, ear, nose and throat operating room. The stand has a heavy base to make it firm, the upper portion has a flexible arm on one side and on the other side a counter weight.



Luer's Articulated Reflector Lamp.



"Moorfields" Electric Lamp, for Ward Use.

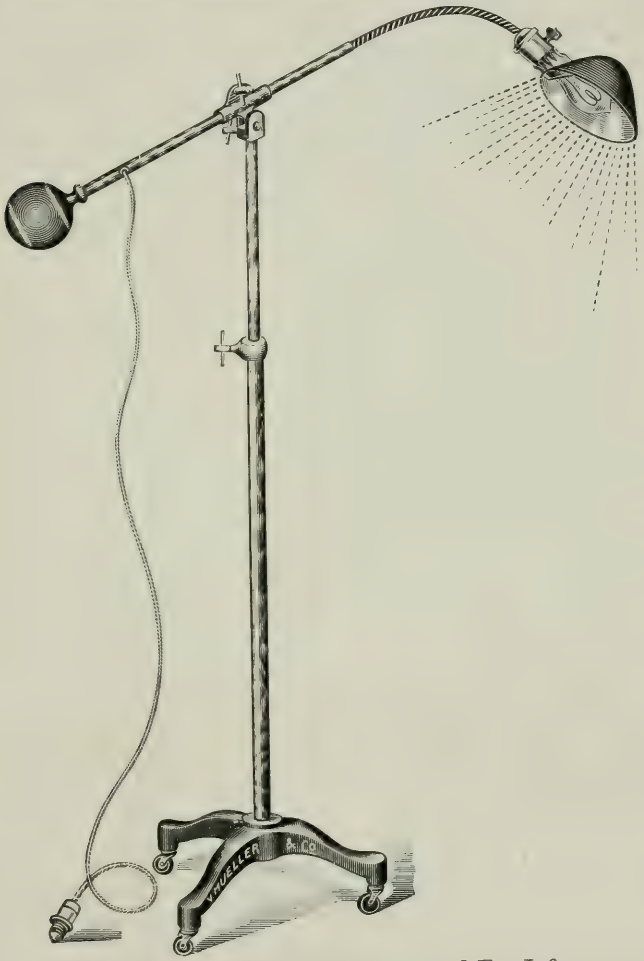
The base is finished in black, the balance of the stand in oxidized copper. See the figure.

A somewhat similar operating lamp (*Meyrowitz Bulletin*, Oct., 1912) is designed to furnish a brilliant and uniform light for the direct illumination of the operative field.

The light is generated by a *Nernst* glower which consists primarily of a section of highly refractory metal which becomes incandescent by the passage through it of the proper electric current. As a result

the light proceeds from a single point of great luminosity and is therefore readily condensed and focused.

The illumination is brilliant, colorless and uniform. At a point four feet from the lamp the illuminated area is ten inches in diameter.



Portable Light on Stand, Illinois Eye and Ear Infirmary.

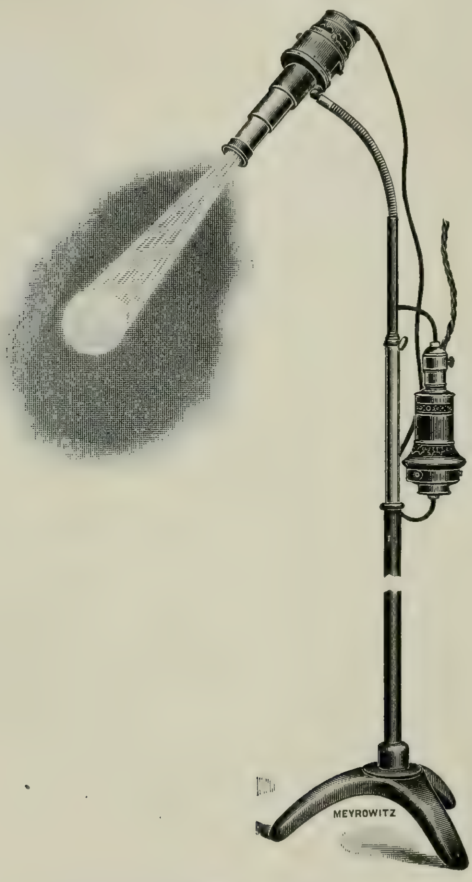
The lamp is mounted on a substantial telescopic stand having a range in height from fifty-two to seventy-five inches. The upper section is flexible, permitting the lamp to be trained in any direction. See the illustration.

The resistance or ballast is mounted at the side of the stand. This is a fixed unit and requires no attention or adjustment. The lamp is

easily removed from the stand and used on the handle as shown. The lamp is also supplied with an iris diaphragm by means of which the circle of illumination may be diminished or increased as desired.

Lamps suitable for operation on any lighting current, direct or alternating, up to 250 volts, can be employed.

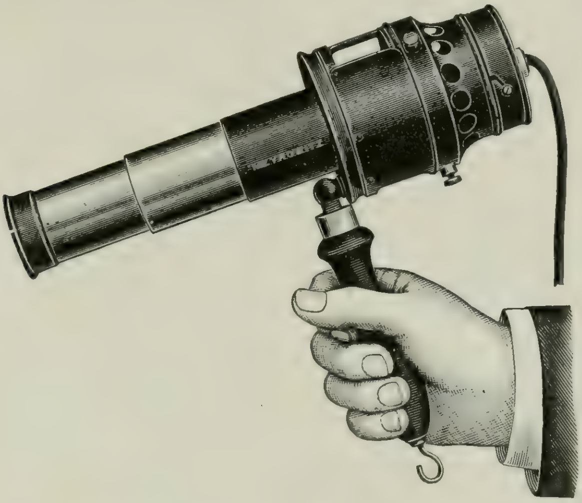
In the same trade journal is also described a useful hand operating lamp. See the figure.



New Operating Lamp. (Meyrowitz.)

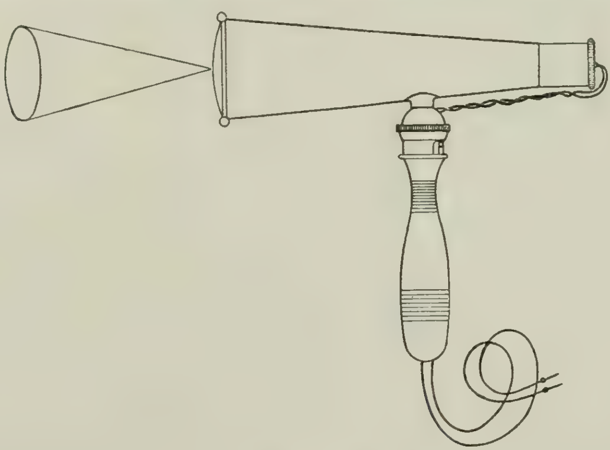
A valuable illuminator for ophthalmic operations is the lamp known in the trade as a projection lamp. It is constructed on the principles of the optical lantern, the light from a special electric lamp being collected by a short focus condenser and the rays projected by an achromatic objective. The result is that a circle of light can be obtained, equally bright from center to periphery; and having a

diameter of 1½ inches when the lamp is held 12 inches away from the object illuminated. By removing one lens the same result may be obtained with the lamp held 1 metre away.



New Hand Operating Lamp. (Meyrowitz.)

The lamp is fitted either with a handle or with an attachment for fitting to a Moorfields bracket. The standard lamps fitted to this



Projection Lamp.

lantern are made to burn on 4 or 10 volt circuits, but they can be used on electric light mains of any voltage, by running them in series with a suitable high voltage lamp. This is most conveniently arranged by

the use of a tap, which is a special form of fitting arranged to plug directly in place of a lamp into any lampholder. Two terminals are provided, from which wires are taken to the series lamp, while the projector fits into the lampholder on the tap; the positions may, of course, be reversed if this arrangement is more convenient. Where a current controller is used to light surgical lamps from the mains, it can be employed to work the projection lamp, and, if necessary, the brilliancy of the beam projected can be altered to requirements. See the figure.

Lamp, Projection. See **Lamps, Ophthalmic.**

Lamprosity. A term proposed by Hiss to indicate the subjective intensity or luminosity of a color sensation, whether achromatic or chromatic.

Lamprotype. A photographic print having a bright surface.

Lamula lacrimalis. The posterior lip of the lacrimal sulcus.

Lamure, François de Bourguignon Bussière, Seigneur de. A famous Monspellensian physiologist, who paid considerable attention to the physiology of the eye. Born at Fort Saint-Pierre (Martinique) in 1717, he received his degree in medicine at Montpellier in 1740. He practised for a time at Montpellier, and became an instructor in medicine. For a time he practised in Paris, but returned to Montpellier, and in 1750, on the death of Rideux, he received a master's chair. He was made a Fellow of the Royal Society of the Sciences, and, shortly before his death, became dean of the Montpellier faculty. He was a ceaseless vivisector, and was widely known as a teacher. He died March 18, 1787.

His only strictly ophthalmic writing was a thesis, written in competition for the professorship above-mentioned, *Presbytiæ Theoriam et Curam Exponere,* in which he takes the position that presbyopia is caused by flattening of the cornea and lens.—(T. H. S.)

Lancée. (F.) Twitch of pain.

Lance knife. Keratome. A two-edged knife the sides of which meet at an angle proportionate to the width of the blade, which varies according to the length of the intended incision. These knives are of two kinds, flat and bent on the flat. In the latter variety the blade should form with the shaft an angle of about 150°. It is chiefly used for preliminary incisions in operations on the iris. See **Iridectomy.**

Lancet of the eyelids. A name for the sycamore (q. v.) tree.

Lancinating. Tearing, darting, or sharply cutting (pain).

Lancisi, Giovanni Maria. Born at Rome Oct. 26, 1654, he studied (as happened in the case of so many famous physicians of his day) at first theology, then medicine. He received his medical degree at the Col-

legio di Sapienza in 1672. In 1684 he became professor of anatomy at the same institution. Among his pupils who afterwards became celebrated were Malpighi and Tozzi. He was finally appointed body physician to Popes Innocent XI and Innocent XII. He died Jan. 21, 1720.

His general achievements (including a number of important books) do not need to be mentioned here. He is chiefly to be remembered by ophthalmologists because of the fact that he was one of the little band (Valsalva, Morgagni, Benevoli, *et al.*) who succeeded in securing the acceptance of "the new cataract doctrine" in Italy. The history of this new doctrine is, in brief, as follows: Throughout antiquity and the middle ages, and even during the first few centuries of the present period, the belief was universal that a cataract consists of a deposit of corrupt and inspissated "humor" in a (wholly imaginary) space between the pupil and the lens. About 1643, Quarré, a Frenchman, began to teach that a cataract is really a hardening and opacification of the lens itself. Rolfinck, a German, in 1656, made actual anatomical demonstration of the truth of this theory. The matter attracted but little immediate attention, and, indeed, was soon forgotten absolutely. Thirty or forty years later, however, two more Frenchmen, Brisseau and Maître Jan, took up the cudgels for the new doctrine, and, after a bitter fight, succeeded in securing its acceptance. To the great Heister belongs the credit of having carried "the new theory about cataract" into Germany. Lancisi and Valsalva repeated at Rome the experiment of couching a cataract in the dead human subject, and then, by dissection, showing that it was really the lens itself that had been "dethroned."—(T. H. S.)

Landau's color test. This is an iodine color-reaction test for syphilis discovered and described by Landau (*Wien. Klin. Wochenschr.*, p. 1702, 1913), who claims for it a high degree of specificity as compared with the Wassermann reaction. John A. Kolmer (*Jour. Am. Med. Assocn.*, May 1, 1915) reports further experiments. Landau at first used iodized petrolatum for the test, prepared by mixing 5 drops of tincture of iodin in 10 cc. of paraffin oil. To 0.2 cc. of the serum was added 2.5 cc. of this reagent and the test tube set aside in a dark place for from five to fifteen hours. Syphilitic serum, it is claimed, decolorizes the mixture, while the color persists, a reddish-yellow with normal serum.

With this method Landau examined the serums of 90 persons regarded as syphilitics; of these 49 reacted positively with the Wassermann reaction and 55 with the iodized petrolatum test. Of 32 controls regarded as non-syphilitic, all reacted negatively with the Wasser-

mann reaction, while 1 (a case of ulcus cruris) reacted positively with the iodin test.

Landau used later a 1 per cent. solution of iodin in tetrachlorid of carbon. To 0.2 cc. of the fresh, clear serum is added 0.01 cc. of the iodin reagent; they are well mixed until all color disappears from the reagent and then set aside in a dark place for four hours at room temperature. With the serum of a syphilitic the fluid is a clear transparent yellow; with a non-syphilitic serum the fluid becomes a whitish-gray and is opaque.

However, Kolmer, of his own experience, does not find the test to be of much value. He says that of eleven serums of persons and four of normal rabbits and dogs reacting positively, and of ten reacting negatively in the Wassermann reaction, the tests with Landau's iodized petrolatum were entirely unsatisfactory. Both normal and luetic serums alike were found to produce partial decolorization of the reagent, and complete decolorization was likewise observed with both normal and luetic serums. The results with active and inactivated serum were practically similar. Cerebrospinal fluids of both syphilitic and non-syphilitic persons tested with iodized petrolatum produced similar results, in that both alike caused little or no change of the reagent. With the iodin in tetrachlorid of carbon reagent the results with fresh active serums after standing four hours at room temperature, as directed by Landau, were as follows: Of seventy-four serums giving a positive Wassermann reaction, 53, or 71.6 per cent., gave a positive iodin reaction. Of sixty-one serums giving a negative Wassermann reaction, 18, or but 29.5 per cent., gave a negative iodin reaction. As based on the Wassermann reaction, the iodin test yielded about 70 per cent. false positive reactions with Wassermann negative serums. The error of the iodin test, therefore, is not only in the low percentage of correct results, but is especially evident in the high percentage of false positive reactions with nonluetic serums. With cerebrospinal fluids the iodin reagent produced no visible changes, irrespective of whether the fluids were from normal or luetic persons.

Landesberg, Max. A well-known Rumanio-Italian ophthalmologist. Born at Jassy, then the capital of Moldavia in Rumania, he received his medical degree at Berlin in 1865, his dissertation being "On Conjunctivitis." Having studied ophthalmology with von Graefe, Schweigger, Schelske, and Waldau, he settled at first in Philadelphia, U. S. A., then removed to New York City, and, finally, to Florence, Italy. Here he died, March 4, 1895.—(T. H. S.)

Landi, Pasquale. An Italian physician, who seems to have paid considerable attention to ophthalmology. Born at Porrona, Nov. 14, 1817,

he received the degree of M. D. at Sienna in 1841. He practised in Florence, Sienna and Pisa, and held a number of teaching positions. The date of his death is not known.

His only ophthalmologic writing is "Dell" Ottalmia Catarrale Epidemica Nelle Milizie Austriache Stanziate in Firenze" (Florence, 1851).—(T. H. S.)

Landolt's bodies. Small elongate bodies between the rods and cones on the outer nuclear layer of the retina.

Landrau, Louis. A well known French ophthalmologist. See **Rivaud-Landrau.**

Landry's disease. LANDRY'S PARALYSIS. Acute *ascending paralysis.* Eye symptoms are rarely found in this disease, although paralysis of the ocular muscles, and of accommodation with dilated pupil and loss of the light reflex are reported.

Landscape lens. A photographic lens specially adapted to landscape photography.

Landscape mirror. A mirror by means of which a condensed image of a landscape is produced.

Lane, Jonathan Homer. (1819-80.) This naturalist was born in Geneseo, N. Y., graduated from Yale and entered the United States Coast Survey in 1847. After a period of service in the patent-office he returned to the coast survey, and thereafter became connected with the bureau of weights and measures (1869-80). He attained considerable note as an astronomer, being sent on expeditions to observe solar eclipses at Des Moines, Iowa (1869), and Catania, Spain (1870). A member of many scientific bodies, he contributed numerous articles on electricity and astronomy to scientific journals. Among his numerous inventions were a machine for finding the roots of the higher equations, a visual telegraph, and an improved basin for the mercurial horizon.

Lanfranc's collyrium. MIXTURE CATHÉRÉTIQUE. According to the French *Codex* this is a preparation consisting of 5 parts each of aloes and myrrh, 10 of copper subacetate, and 15 of purified arsenic trisulphide, powdered and mixed with 1,000 parts of white wine, to which 380 parts of distilled water of roses are subsequently added.

Langdauernd. (G.) Long-lived; chronic.

Langenbeck, Bernhard Rudolph Konrad von. One of the greatest surgeons of all time, and a man of some importance ophthalmologically, having been the first to show that medullary sarcoma of the retina consists essentially of a hyperplasia of the normal retinal cells. Born Nov. 9, 1810, at Horneburg, Germany, the nephew of K. Martin Langenbeck, and cousin of Maximilian Adolf Langenbeck, he received

his medical degree at Göttingen, in 1835, presenting the dissertation, "De Retinæ Structura Penitiore." After a year or more of scientific travel, he qualified as privatdocent in Göttingen, but later was made extraordinary professor. In 1842 he was called to the chair of surgery at Kiel, a position which he resigned in 1848 to accept the position of general staff physician of the army in the war against Denmark. In the same year he was made professor of surgery at Berlin, and this position he held with high distinction till 1882, i. e., for thirty-four years. He died at Wiesbaden, Sept. 29, 1887.

In addition to the graduation dissertation mentioned above (and numerous papers on general and surgical subjects) Langenbeck wrote "De Retina Observationes Anatomico-Pathologicæ" (Göttingen, 1836), in which he recorded his observations on medullary retinal sarcoma. —(T. H. S.)

Langenbeck, Konrad Johann Martin. A well-known German anatomist, surgeon, and ophthalmologist, father of Maximilian Adolf Langenbeck and uncle of the famous Bernhard Rudolph Konrad von Langenbeck. Born at Horneburg, Germany, Dec. 5, 1776, he received his medical degree at Jena in 1798, presenting as a dissertation "Diss. Inaug. Sistens Paradoxa Medica Secula XVIII." He then proceeded to study for a time in Vienna, where his attention was directed especially to ophthalmology by Joseph Beer. Returning to Horneburg, he practised there for one year; then, having been decreed by the Government a stipend for the purpose, he studied at Würzburg and, once more, at Vienna.

In 1802 he became privatdocent at Göttingen, as well as surgeon to the Academic Hospital. Owing, however, to disagreements with Himly, with whom he was associated in this hospital, he resigned his post in 1807, and founded a Clinical Institute for Surgery and Ophthalmology in a newly constructed surgical hospital in the same city.

In 1814 he became full professor of anatomy and surgery, as well as surgeon-general of the Hanoverian army. In 1816 he became an aulic councillor. In 1840 he was made Superior Medical Councillor, but in 1848, in consequence of certain machinations against him, he was ousted from the surgical chair, though allowed to retain the anatomical. This embittered his life, and, according to Gurlt, did much to hasten his death. He died Jan. 24, 1851, in his 75th year.

Langenbeck was a man of impressive presence, brilliant intellect and eloquent speech. He was a rapid and dextrous operator, partly from his very nature, but more, perhaps, from his absolute mastery of anatomy and of operative technique. He arose early and worked late, and many are the tales of his seemingly inexhaustible energy and

patience. Yet he had his limitations. A man of single and inflexible purpose, he possessed no liking for the world outside of medicine. Painting and sculpture, music and the finer sorts of literature, were completely lost upon him. The only kind of architecture in which he felt the slightest interest related to the construction of hospitals. He took no recreation, and believed that amusements were unnecessary. Yet, as remarked by Stromeyer, " . . . the world remained uninterested in him, for people do not become enthusiastic over the fact that some one gets up earlier than other folks. Genius often sleeps well into the open day . . . Never did Langenbeck discover a thing of value in anatomy, and, in surgery, he did but little better."

Langenbeck's most important ophthalmologic writings are: 1. Prüfung der Keratonyxis. (1811. Also, *Bibl. f. Chir.*, 1809, II, p. 537; 1811, IV, p. 33. *Neue Bibl.*, 1818, I, and 1820, II, p. 418.) 2. Ueber Trichiasis und Entropium. (*Neue Bibl. f. Chir. und Ophth.*, I, 3, 415, 1818.) 3. Künstliche Pupillen-Bildung. (N. B., I, 676-736.) 4. Belladonna Erweitert, Erst nach der Blut-Entleerung, die Pupille. (N. B., II, 13.) 5. Ueber Exophthalmos. (N. B., III, p. 329.) 6. Ansichten des Baues vom Menschlichen Auge, Welche bei der Star-Operation, bei der Pupillen-Bildung und beim Schwarzen Star von Wichtigkeit sind, durch Abbildungen Erlaütert. (N. B., III, 1 and 2.) 7. Förderung des Ophthalmologischen Studium. (N. B., III, p. 453.) 8. Ein Neuer Wirkungskreis meines Koreoncion. (N. B., IV, p. 98, 1822.) 9. Der Nervus Sympathicus in der Pathogenie. (N. B., IV, p. 729, 1828.)—(T. H. S.)

Langenbeck, Maximilian Adolf. A well known German ophthalmologist, son of Konrad Johann Martin Langenbeck, and cousin of the renowned Bernhard Rudolph Konrad von Langenbeck. Born at Göttingen, Germany, Jan. 11, 1818, he studied at Göttingen, Paris, Vienna, Berlin, and again at Göttingen at the latter university receiving his medical degree in 1842. The following year he qualified as privatdocent at his *alma mater* in anatomy, surgery and ophthalmology. In 1846 he was made extraordinary professor, but in 1851, because of the death of his father, he settled at Hannover, where he practised many years. In 1865 he was called to the Upper Medical Collegium, but soon resigned, and died May 2, 1877.

Maximilian Adolf Langenbeck is chiefly to be remembered as the reinventor and the only effectual introducer of the fixation (fixing) forceps. He was also instrumental in securing the final victory of cataract extraction over the needle operation.

In addition to numerous works of a general surgical character, he wrote: 1. Klinische Beiträge aus dem Gebiet der Chirurgie und

Ophthalmologie. (Göttingen, 1849.) 2. Die Insolation des Menschlichen Auges, oder Glaskörperstich und die Accomodationsfasern. (Hannover, 1859.) 3. Lehre von der Accomodation und ihre Störungen. (Memorabilien, 1870.)—(T. H. S.)

Langer schiefe Augenmuskel. (G.) The superior oblique muscle of the eye.

Lange's test. By this reaction the presence of protein (globulin) is detached in the cerebrospinal fluid, and thus the diagnosis of cerebrospinal syphilis is made. It is performed by the addition of a preparation of colloidal gold to ten dilutions of spinal fluid, ranging from 1:10 to 1:5120. The results are interpreted according to the changes in color which result. When no change occurs the reaction is negative and is recorded as 0. The color changes depend upon the amount of gold precipitated and are recorded as 1, 2, 3, 4, 5, the last being clear, owing to complete precipitation of the gold. Syphilis of the nervous system gives a reaction in the first five dilutions; tuberculous meningitis reacts in the middle dilutions, pyogenic meningitis reacts in the high dilutions, while general paresis gives a reaction different from that given by cerebrospinal syphilis or tabes. Called also *gold-solution test* and *colloidal gold chlorid test.* (Dorland.)

See, also, **Syphilis of the eye.**

Langhans, Method of. A staining method for the detection of amyloid. Stain in Lugol's solution for from five to fifteen minutes; dehydrate in a solution composed of tincture of iodin, 1.0; absolute alcohol, 4.0; clear and preserve the specimen in origanum-oil by rimming the cover.

Lang, John. A well-known Scotch-Canadian ophthalmologist. Born at Dumbarton, Scotland, Aug. 1, 1859, he became L. R. C. P. (Edinburgh) and L. F. P. S. (Glasgow). In 1884 he was House Physician to the Glasgow Eye Infirmary, then lived in China seven years, being there in charge of the Amoy Mission Hospital. In 1892 he removed to Victoria, B. C., where he practised with great success as ophthalmologist, and was ophthalmic surgeon to the Provincial Royal Jubilee Hospital. He received a number of severe injuries in the Point Ellice Bridge accident, May 26, 1896, and, in consequence, died a few weeks later.—(T. H. S.)

Langley, Samuel Pierpont, (1834-1906), was born at Roxbury, Mass. From 1887 he was secretary of the Smithsonian Institution. He greatly advanced solar physics, invented the bolometer for measuring radiant heat, and devised an aeroplane for flight. Educated at the Boston Latin School, the Boston High School and in Europe, he subsequently practised for some time as a civil engineer and architect in

Chicago and St. Louis. Assistant at Harvard Observatory (1865), assistant professor of mathematics and director of the observatory in the Naval Academy at Annapolis, professor of astronomy and physics in the Western University of Pennsylvania, at Pittsburgh (1867), and director of the Alleghany Observatory, he originated in 1869 the system of railroad time service from observatories. He conducted solar observations at Pike's Peak in 1878, at Mt. Etna during 1878-79, and at Mt. Whitney, Cal., in 1881, in which year he re-established the solar constant and discovered an unexpected extension of the invisible solar spectrum. He received the Jannsen medal of the Institute of France, the Rumford medal of the Royal Society of London, and many other distinctions. In 1897 he announced the attainment of mechanical flight, a subject in which he had experimented for some time. His investigations into lifting force and air resistance have proved valuable to modern aeronauts. He was, of course, greatly handicapped by having to employ steam engines for providing motive power. His machine, intended to sustain the weight of a man, was damaged in launching, and the government withdrew its financial support. Nevertheless, his large models successfully solved the problem of mechanical flight by heavier-than-air machines.—(*Standard Encyclopedia.*)

Längsdurchmesser. (G.) A longitudinal diameter.

Langsichtigkeit. (G.) Hypermetropia.

Längsmittellinie (des Sehfeldes). (G.) Equatorial section longitudinal median line (of the visual field).

Lannegrace. A Monspellensian professor of physiology who devoted some attention to the physiology of vision. The date and place of his birth are not ascertainable. He was made associate professor of anatomy at Montpellier in 1878, and, in 1885, succeeded Rouget in the chair of physiology. In the "*Archives de Médecine Expérimentale*" (1885) he describes a number of experiments, performed on dogs and monkeys, in which he seeks (1) to establish that cortical lesions in the brain of the dog and of the monkey produce, according to their seat, sometimes homonymous hemianopia, sometimes crossed amblyopia; (2) to demonstrate the mechanism by which cortical lesions produce these two kinds of visual defects. Lannegrace died in 1890.—(T. H. S.)

Lanoform. An antiseptic mixture of lanolin with 1 per cent. of formaldehyd.

Lanolin. Adeps lanæ hydrosus. Hydrous wool-fat. This is sheep's wool-fat purified for medicinal purposes. It contains 25 per cent. of water, and is a whitish-yellow, neutral, fatty mass having a peculiar wool-like odor, easily miscible with twice its weight of water,

This remedy is used alone as an application to excoriated lids, in various forms of blepharitis and as an excipient in combination with other agents. If it is found of too stiff consistence for general use in these conditions it may be diluted with water, cold cream or petroleum. It ought, *a priori*, to be the ideal base for salves, as it is an animal product derived from dermal oil glands but, clinically, it does not strike one as superior to pure lard and other fatty products. In lesions of the external canthus, however, its adherent qualities enable it to resist well the action of the tears and for that reason it is well adapted for ointments to be applied in that locality.

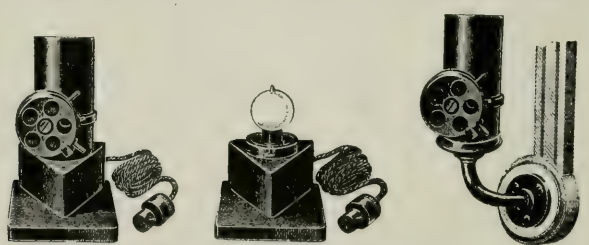
Darier (*Thérapeutique Oculaire*, p. 21) advises for finger massage mercurial lanoline. This is a preparation put up by certain Paris druggists in gelatine capsules, each containing four grammes. He believes this preparation undergoes slighter alterations, is more easily absorbed than similar preparations of mercury and is, consequently, well adapted to lid friction.

Vacher uses for the same purpose what he calls compound gray oil. This, Darier says, has about the same formula as his mercurial lanoline. See, also, **Lanoform.**

Lanternoscope. An instrument (useful in ophthalmic teaching) for showing lantern slides.

Lantern slides. Glass transparencies intended for projection by means of a stereopticon or magic lantern.

Lantern tests for defective eyesight. This subject—especially in its relations to detecting color-blindness—has been discussed and illus-



Lantern for Testing Color Perception. (Harrison Butler.)

trated under various appropriate captions elsewhere in this *Encyclopedia*. See, for example, **Color-sense and color-blindness**; also p. 4677, Vol. VI of this *Encyclopedia;* and **Eyes of soldiers, sailors, etc.**

Recently, Harrison Butler (*Ophthalmoscope,* p. 598, Oct., 1914) has described a simple and cheap lantern for testing color perception which he describes as follows:

The source of light is an ordinary commercial 8-volt carbon filament

frosted lamp, which can be obtained for any usual voltage, and can be easily replaced when broken. Immediately in front of the lamp (see the figures) is an iris diaphragm, and in front of this again are two metal discs which carry the colored glasses and the modifying glasses. An efficient "click" is provided which arrests the discs when any desired color is centered before the lamp. There are four colors, and four degrees of smoked glass. One aperture in each disc is left free for the passage of the ordinary yellow lamp light. The colors are red, green, blue and purple. The blue light is obtained by the use of a carefully chosen purple and green glass placed in approximation. This mixture gives a very satisfactory blue with carbon filament illumination. The green is British Board of Trade "signal green." It will be seen that the lantern is quite simple and can be managed by a non-medical examiner. It also contains no fancy combination of colors which may confuse the candidate, who is not expected to be a color specialist. He simply has to name white, red, and green, and if he can do so when the red is modified by the smoked glasses, he is fit for the railway and marine services. The blue and purple can be used to make the examination more searching.

The lantern can be employed for the examination of the muscle balance with the Maddox-rod, and the iris diaphragm is useful to test for color scotomata in cases of retrobulbar neuritis. It is here that the blue glass is especially necessary.

The lantern is superior to the Board of Trade appliance in that it possesses a range of smoked glasses which enables a candidate to be excluded who has his spectrum shortened at the red end. It is not an elaborate scientific instrument like that "best of all lanterns, the Edridge-Green color perception lamp," but is a simple, practical tool which can be understood by the laity. For routine departmental work it will do all that is really necessary. The lantern is made either in portable form, or to fix to a wall.

Lanthopin. A white, crystalline alkaloid, from opium.

Lantol. Colloidal rhodium for use in cancer and septic diseases.

Lanuginous. Covered with downy hairs.

Lanugo. The downy hair that appears on the fetus during the fifth month of development. Similar hairs are seen on some parts of the surface of the adult body, e. g. on the lids and on the faces of girls.

Lanum. Hydrous wool-fat; a yellowish-white, unctuous mass, miscible with water. See **Lanolin.**

Lanzenmesser. (G.) Keratome.

Lapis. (L.) A stone; a stony concretion.

Lapis chelidonius. (L.) A small stone said to be found in the stomach

of the swallow; formerly worn as an amulet in epilepsy and placed between the eyelids to remove foreign bodies from the eyes.

Lapis divinus. Cuprum aluminatum. Aluminated copper. This agent is prepared by fusing together copper sulphate, potassium nitrate, alum and camphor. The semi-liquid mass may be moulded into pencils. It is a bluish, non-crystalline mass with a greasy appearance. For several years the Editor has been in the habit of using this stick as a substitute for crystals of sulphate of copper in trachoma, etc., and believes it to be just as efficacious and much less disagreeable to the patient than the pure copper sulphate. In the French pharmacopeia an eyewater—used in trachoma and other forms of granular lids—is official under the name *collyre de pierre divine.* This is made by dissolving 4 parts of aluminated copper in 1,000 parts of water.

Another prescription is as follows: Cupri aluminati, 0.05—0.1 gm. (gr. 7-16 ad iss); aquæ dest., 120.0 cc. (℥ iv); tincture opii, 0.2 cc. (m iij); glycerini, 2.0 cc. (f ʒ ss); misce et fiat in collyrium. After applications of the solid compound one should flush the eye with a mild, aseptic wash such as one per cent. salt water, or a two per cent. borax or boric acid solution.

Lapis infernalis. Nitrate of silver stick or crystals.

Lapis ophthalmicus. *Cuprum aluminatum.* See **Lapis divinus.**

Lapis sassenagensis. (L.) A small stone which is inserted between the eyelids for the purpose of removing foreign bodies.

Laplace, Pierre Simon, Marquis De, (1749-1829), the greatest of French mathematicians, was the son of a farmer at Beaumont near Trouville. He studied at Caen, and at Paris, where he attracted the notice of D'Alembert by a paper on dynamics. When professor in the Royal Military School he acquired a reputation by his mastery of mathematical science and its application to practical astronomy—solving a problem which both Euler and Lagrange had grappled in vain. Associate of the Academy of Sciences in 1773 and member in 1785, he established the generalization that our planetary system is stable—that what had been termed irregularities were not disturbing the general equilibrium, but necessary to it. This solution of the "mechanical problem of the solar system," as he termed it, has bestowed upon astronomy the "Three Laws of Laplace." The insight of Laplace as an astronomer was apparent in his explanation of the "secular inequalities" in the motions of the planets Jupiter and Saturn. He was the first to construct a complete theory of the satellites of Jupiter, and his investigation of the tidal theory has been characterized by Airy as "one of the most splendid works" in the history of mathematics.

After the 18th Brumaire, Bonaparte made him Minister of the Interior. In 1799 Laplace entered the senate, and in 1803 he was appointed chancellor. He was created count under the empire, and in 1815 a peer, in 1817 a marquis, by Louis XVIII. Elected to the Academy in 1816, he was next year president. In his memoir on the "attraction of spheroids" are first set forth the two celebrated means of applying analysis to physical problems—Laplace's coefficients and the potential function—which are requisite in the theory of attractions and in the more abstruse parts of electrical science.—(*Standard Encyclopedia.*)

Läppchen. (G.) The cavity, or saccular recess, in the finest lobule of a racemose gland.

Lappen. (G.) Flap; lobe.

Lapsus. (L.) Falling or dropping of a part; ptosis.

Laqueur, Ludwig. A celebrated German ophthalmologist, especially renowned for his studies in glaucoma and sympathetic ophthalmia. Born at Festenburg, Silesia, July 25, 1839, he studied medicine at Breslau, Berlin, and Paris, receiving the degree of M. D. at Berlin in 1860, and at Paris in 1869. For a time he practised as ophthalmologist at Lyons, France, but, in 1872, was made extraordinary professor of ophthalmology at Strassburg, and, five years later, full professor as well as Director of the University Hospital for Eye-Patients in the same institution.

Laquer is generally given the credit for having introduced physostigmine for glaucoma. He wrote a large number of articles on the subject of glaucoma, and suffered from the disease himself. Operated on by Horner, he recovered his vision.

An abstract of Laquer's "An Account of My Own Case: Glaucoma" was made by H. Herbert, as follows: "This is the third instance of the publication of a personal experience of chronic glaucoma by an ophthalmic surgeon. There is nothing exceptional in the facts. But eye surgeons must feel an interest in the personal narrative of one of themselves, a trained and accurate observer.

Laqueur, like Javal, was a Jew, exemplifying the racial predisposition. His case fortunately ended well, like that of W. Wagner of Odessa, and in contrast with Javal's well-known tragic record. The present account, published after the patient's death, was written in 1902, twenty-two years after a cure, obtained by iridectomy in both eyes. There were thus many years during which Laqueur was able to appreciate the debt which he owed to von Graefe, who had rendered cure by operation possible.

Laqueur states that his eyes were always somewhat sensitive to light.

This sensitiveness was increased during numerous recurrences of slight conjunctivitis, which troubled him from the age of 22 onwards, so that he frequently had recourse to the use of neutral-tinted glasses. Both eyes were emmetropic until at the age of 33 he acquired a slight astigmatism of the right eye, 0.75 D with the rule, apparently from the pressure of a pince-nez with a strong spring, worn during a three weeks' holiday.

At 35 years of age the prodromal stages of glaucoma began with the appearance of a mist before the right eye one hot day in July, 1874, as he was returning late to mid-day dinner, very tired. During the meal the mist appeared also before the left eye, and when he turned on a light he saw the ominous colored rings which were to embitter his life in the following years. The hardness of both eyes confirmed the diagnosis. The symptoms passed off in a few hours, and did not return for two or three months. Subsequent seizures were almost all confined to the right eye. Of these there occurred many hundreds, the intervals between them gradually lessening until sometimes three attacks occurred in one day, each lasting an hour or more. Occasionally they occurred even during the night or on awakening in the early morning. (A detailed description of the symptoms was published in v. Graefe's *Archiv*, Bd. XXXI.)

The diameter of the halo-figure measured only 8°–9°. In the severer attacks of rather long duration the colors of the rings were paler, and even disappeared altogether at times, thus producing a colorless halo. There was neither pain nor marked injection of the eyes at any time; nor was there any contraction of the visual field, though the visual acuteness sank to $\frac{3}{4}$–$\frac{1}{10}$ of normal during the attacks of tension.

Among the exciting causes of the attacks there came more and more into evidence the influence of the emotions—anger, passion, shame, and even the pleasurable excitement of stirring music or of a theatrical performance. Want of food, also breathing bad air in close, stuffy rooms, brought on a rise of tension, which, on the other hand, was shortened or ended by exercise in the open air. In 1876 the patient learned the value of physostigmine, and afterwards obtained unfailing relief by it, a single instillation always sufficing.

The frequent recurrences, interfering with his work, led him to consult Horner, of Zurich, in December, 1878. The latter advised palliative treatment for a time, with strict dieting and small doses of quinine. But in March, 1880, he iridectomised the right eye. In those days cocaine-anesthesia was not known. The operation was thus performed without an anesthetic, the eye being free from injection or tension at the time. (The visual acuteness and visual field still

remained normal.) The incision was made with a keratome, and the pain resembled that of a somewhat severe burn. The healing was uncomplicated. A week later the left eye was similarly operated upon, a warning attack of increased tension having occurred in it. The operation on this eye was followed by acute pain and injection. The onset of ''malignant glaucoma'' was feared, but the pain subsided after an injection of morphia, and there was no more trouble. The operations left astigmatism of 0.75 D against the rule in each eye.

A year later there was one small recurrence of glaucomatous symptoms. Except for this there was no trace of tension or of its results during the remaining 28 or 29 years of the patient's life. The only troubles were some increase of the old sensitiveness to light, due to the colobomata, and annoyance and worry from the curiosity and ill-manners of people who noticed and commented upon the abnormal appearance produced by the iridectomies.''

Laqueur died of some pulmonary affection April 20, 1909. His most important writings are as follows: 1. Études sur les Affections Sympatiques de l'Oeil. (Paris, 1869.) 2. Études Cliniques sur le Glaucome. (*Ann. d'Oculist.*, 1869.) 3. Sur les Changements Brusques de la Refraction. (Ib.) 4. Ueber Atropin u. Physostigmin. (v. Graefe's *Arch.*, XXIII.) 5. Das Prodromalstadium des Glaucoms. (Ib., XXVI.)—(T. H. S.)

Lard. ADEPS. ADEPS SUILLUS. AXUNGIA PORCI. Lard is the purified abdominal fat of the hog; a soft, white, unctuous solid, with a faint, non-rancid odor. The most important constituent of lard is stearin. It is commonly used in ocular therapy as a basis for ointments. For example: Hydrargyri oxidi flavi, 0.2 gm. (gr. iii); Ceræ alb., 1.5 gm. (fr. xxij); Adipis, 3.5 gm. (gr. lix.). The value of pure lard alone as an emollient in marginal blepharitis must not be forgotten. It is quite likely that the good results that flow from ointments are often due to the presence of the greasy excipient and not to the supposedly active ingredients.

Lardaceous. Resembling lard; containing lardacein, or amyloid substance.

Lardner, Dionysius, (1793-1859), was a popularizer of physical science; born in Dublin, Ireland, and educated at Trinity College, Dublin. He first attracted attention by a *Treatise on Algebraic Geometry* (1823), and a work on *Differential and Integral Calculus* (1825). He is best known as editor of Lardner's *Cyclopædia*, 132 volumes on scientific subjects, published between 1830 and 1844. Lardner himself wrote the volumes treating of mechanics, hydrostatics, geometry, arithmetic, heat, and electricity. This was followed up by the his-

torical *Cabinet Library* (12 vols. 1830-32) and *Museum of Science and Art* (12 vols. 1854-56). He also wrote handbooks of natural philosophy. In 1828 Lardner was professor of Natural Philosophy and Astronomy in University College, London; but in 1840 lost his chair through running away with the wife of an army officer, who claimed $40,000 damages. Lardner then came to the United States, where he made five times that sum by lecturing. He lived in Paris from 1845 to 1859, and died at Naples.—(*Standard Encyclopedia.*)

Largin. SILVER-PROTALBIN. A grayish powder containing about 11 per cent. of silver; soluble in 10 parts of water, insoluble in ether and alcohol. It is bactericide and astringent and belongs to the numerous class of argentic nitrate substitutes. In from 2 to 10 per cent. solution it may be applied with a brush over the exposed conjunctiva once or twice a day. Its application, even in the concentrated form, is painless, but may stain the conjunctiva. It acts well in blepharo conjunctivitis and in some cases of dacryocystitis, and forms a valuable substitute for silver nitrate in the Koch-Weeks bacillus infections.

Larme. (F.) Tear.

Larmoiement. (F.) Epiphora; lacrimation.

Larva. The young of an animal when it assumes a form different from that of its parent, which latter it afterward assumes, e. g., a caterpillar, a tadpole. The larvæ of diptera (see the introduction to **Comparative ophthalmology**) occasionally invade the ocular tissues, especially the conjunctival sac and anterior chamber. See, for example, *Trans. Oph. Soc. U. K.,* Fasc. 1, p. 14, 1909.

Larvaceous. LARVAL. LARVATE. LARVATED. Masked; concealed. Said of a disease or a symptom of disease.

Larvaire. (F.) Pertaining to larvæ.

Larval conjunctivitis. A definition of this form of conjunctival infection is given on p. 3113, Vol. IV of this *Encyclopedia.* Here mention may be made of the case of Farmakovski (*Ophthal. Year-Book,* p. 415, 1914) occurring in a boy, 5 years of age, who complained of pain in the eye of several hours' duration. On close observation several dark, moving spots were seen trying to escape from the tears into the depth of the conjunctiva. An attempt to remove them resulted in their becoming firmly attached. A 4 per cent. solution of cocain was then instilled, and produced a paralysis of the movements of the black spots, which were then captured. Microscopic examination of the latter showed them to be transparent bodies with well-defined organs. Two dark hooks projected from their heads, the hooks corresponding to the black points in the conjunctiva.

Lashes, Ingrowing. See **Entropion.**

Lasiocampa pini. One of the numerous caterpillars whose hairs produce ophthalmia nodosa (q. v.).

Lasnier, Henry (or Rémi). A Parisian surgeon, ophthalmologist and cutter for stone, who flourished in the 17th century, dying about 1690. He is often declared to be the first in history to teach the true nature and location of cataract. This, however, is probably a mistake. At all events, the testimony is merely heresay, resting as it does on a statement of Palfyn (1650-1730) that an old surgeon had told him that Lasnier had told him, etc. The first to teach the true doctrine was, no doubt, Quarré, and the first to confirm it by anatomical dissection was Rolfinck.—(T. H. S.)

Lassell, William, (1799-1880), astronomer, born at Bolton, in Lancashire, England. He built a private observatory at Starfield, near Liverpool, about 1820. He also constructed reflecting telescopes of 9 in. aperture and 2 ft. aperture successively. The speculum of the latter was polished by means of a machine of Lassell's own invention. With this telescope he discovered the satellite of Neptune (1847); the eighth satellite of Saturn (1848), simultaneously with Professor Bond of Harvard; and two new satellites of Uranus (1851). In 1861 he set up at Malta a reflecting telescope of 4 ft. aperture and 37 ft. focal length, mounted equatorially; and made observations until 1865, chiefly of nebulæ and satellites. After his return to England he transferred his observatory to Maidenhead. See *Memoirs of Astron. Soc.,* Vol. XXXVI., for his work in Malta, and *Trans. Roy. Soc.* (1874) for a description of his polishing-machine.—(*Standard Encyclopedia.*)

Latent deviation. A term applied to imbalance of the ocular muscles, or heterophoria.

Latent hypermetropia. When concealed by the accommodation in either near or distant vision—as often occurs in young subjects—hyperopia is called latent.

Latent image. The invisible image resulting from the action of light on the sensitive photographic plate.

Latent light. Light to which the eye is insensible.

Latent paresis. LATENT STRABISMUS. In low degrees of oculomotor paresis, especially of one of the lateral muscles, all appearance of paralysis may be masked by fusion movements. The paralysis is therefore latent, and a condition is present not unlike that which obtains in an insufficiency of the internal recti. Its existence is betrayed by temporary double vision, asthenopia; and by proper tests it may be distinguished from insufficiency, especially by the so-called cover test. See **Examination of the eye.**

Latent range. See **Refraction and accommodation of the eye.**

Lateral aberration. A term applied to the distance of a ray from the geometrical focus, measured at right angles to the axis. See, also, **Aberration.**

Lateral illumination. See **Examination of the eye**; p. 4601, Vol. VI of this *Encyclopedia.*

Lateral magnification. See **Magnification.**

Lateriflection. Lateroflection. A bending sideways.

Lateritypy. Bilateral symmetry.

Lateroduction. Movement of an eye to either side.

Laterofrontal. Situated on the side and towards the front.

Lateromarginal. Situated on the side and edge.

Lateroposition. Displacement to one side.

Lateropulsion. An involuntary tendency to go to one side.

Laterotorsion. Twisting of the vertical meridian of the eye to the right or to the left.

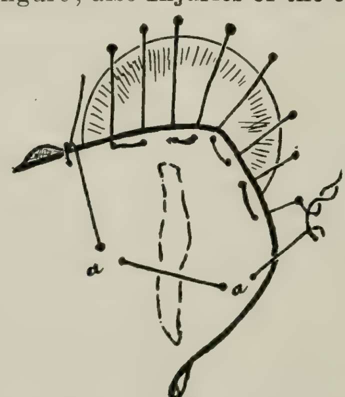
Lateroversion. A turning to one side.

Latescent. Becoming latent or obscure.

Lattice-like cataract. A name given to several different cataract forms in which the opacities, as seen by the ophthalmoscope, take on the appearance indicated by the name. See **Cataract, Senile.**

Lattice-shaped opacity of the cornea. Grill-like keratitis or corneal opacity. Reticular opacities of the cornea. This corneal disease is distinguished from nodular opacity principally by the presence of radiating and intersecting linear opacities passing through the dust-like, gray dots, which form a fine net-work having the appearance of a cobweb. See p. 3382, Vol. V of this *Encyclopedia.*

Lattice suture. A method of suturing after the manner of Kuhnt the conjunctiva over the cornea in ulcer and injury of it, invented by E. E. Maddox. See figure; also **Injuries of the eye.**



Maddox's Lattice Suturing of the Conjunctiva.

Lattichsaft. (G.) Lettuce juice.

Laudable. Of a kind thought to indicate an improving condition; formerly said of pus.

Laudanin. An alkaloid from opium, occurring in colorless hexagonal prisms.

Laudanon. A proprietary combination of various opium alkaloids.

Laudanosin. A colorless alkaloid in prismatic crystals; a derivative of opium.

Laudanum. The tincture of opium.

Lauf. (G.) Course.

Laughing gas. Nitrogen monoxide, or nitrous oxide; so called on account of its exhilarating effects when inhaled (as an anesthetic).

Laugier, Stanislas. A famous French surgeon, of some ophthalmologic importance. Born at Paris, Jan. 28, 1799, he received his medical degree in 1828, and, next year, was associate professor on the Faculty. In 1831 he was appointed surgeon to the Central Bureau, as well as consulting surgeon to King Louis Phillipe. After this he was on the staff of many hospitals, but the most of his work was done at the Hôtel Dieu, where he served from 1854 until his death—about eighteen years. In 1848 he received the full professorship. He was a distinguished teacher and operator, especially renowned for the cataract operation, as well as for the various procedures employed in diseased conditions of the lacrimal drainage system. He died suddenly Feb. 15, 1872.

His writings relate almost exclusively to general surgery. However, in 1845, he, in collaboration with G. Richelot, published a French translation of Mackenzie's "*Textbook of Diseases of the Eye,*" with numerous notes. Laugier also published articles in the "*Annales d'Oculistique*" on the suction operation for cataract, on a depression needle, on false hypopion, and on the symblepharon operation.—(T. H. S.)

Laurel. Laurus nobilis. The leaves of the laurel were used in ancient Greco-Roman times as a local application for "inflammation of the eyes."—(T. H. S.)

Laurel water. Cherry-laurel water is made by distilling the fresh leaves of *Prunus lauro-cerasus* with water. In the Br. preparation each pint (imp.) of the product represents a pound of the leaves; in the Fr. preparation, 3 parts of the product represent 2 parts of the leaves. The Fr. *Codex,* however, directs that for medicinal use the water should be diluted till it contains only 1 part in 2,000 of hydrocyanic acid. See p. 543, Vol. I of this *Encyclopedia.*

Laurence, J. Zachariah. A celebrated English ophthalmologist, concerning whose life but little is known. Neither the place of his birth

or of his death, seems, now, to be ascertainable. In 1857 he founded the Ophthalmic Hospital, at Southwark, at which institution he was surgeon for sixteen years. In 1865, together with Thomas Windsor, he founded, at Manchester, the *Ophthalmic Review**—an excellent but ill-starred journal which only existed through three volumes.—(T. H. S.)

Laurence's test for feigned blindness. See **Hogg's test.**

Laurens, André du. A 16th century professor of anatomy at Montpellier, France, who devoted considerable attention to the anatomy and physiology of the eye. Born at Arles, he studied at Montpellier, and there received his medical degree in 1583. Three years later he succeeded to the chair of anatomy, which had just been made vacant by the death of Laurent Joubert. In 1600 he was called to Paris, there to become physician-in-ordinary to Henry IV. Three years later he was elected chancellor of the University of Montpellier, though still residing at Paris, where, in fact, he continued to live until his decease, Aug. 16, 1609.

Laurens wrote four books, the most important of which is *Historia Anatomica Humani Corporis* (Erfurt, 1595; Paris, 1598, and various later editions in various cities). Ten chapters, in this book, are devoted to the anatomy and physiology of the eye. The anatomy is merely a rehash of Vesalius, while, on the other hand, the physiology is chiefly concerned with these questions: Whether vision is caused by emission or reception? Whether anything can be seen within the eye? Why eyes are of different color? On the movements of the eyes: in all of which he merely repeats the theories of Galen and even of Aristotle.—(T. H. S.)

Laurens, Frère. A French empiric of the 18th century, concerning whom we know but little. He was, for a time, a Jesuit priest, then an apothecary at Rhodes. According to the *Courrier d'Avignon* for Oct. 10, 1763, he cured obstructions, jaundice, hydropsia, hysterical vapors and dysentery, and removed spots from the eyes, both drying up their sources and fortifying and clarifying the vision.—(T. H. S.)

Laurocerasus. The European cherry-laurel. See **Aqua laurocerasi.**

Laus. (G.) Louse.

Laut. (G.) A sound.

Lauth, Canal of. A name for the circular sinus or canal of Schlemm.

Lavage. (F.) Irrigation.

Lavement. (F.) Enema.

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* The first English journal of that name. The present *Ophthalmic Review* was founded in 1882 by Karl Grossmann, of Liverpool, and Priestley Smith, of Birmingham.

Laveran, L. A French military physician, who devoted considerable attention to ophthalmology. Born at Dunkirk, May 30, 1812, he studied at Lille, practised for a time in the Hospital at Algiers, in 1841 was professor at the Military Hospital at Metz, returned to Algeria, then became instructor in military diseases at Val-de-Grâce. He has been called the creator of French military epidemiology. He died at Paris Aug. 7, 1879.

Laveran's ophthalmologic writings are as follows: 1. Note sur la Nature de la Héméralopie. (*Rec. de Mém. de Méd.* Mil., 1858.) 2. Rapport Adressé au Ministre de la Guerre sur les Faits Recueillis au Congres Ophthalmologique de Bruxelles. (*Ibid.,* 2d series, Vol. XX.)—(T. H. S.)

Laverania (malariæ). A genus of animal parasites (Laveran's bodies or corpuscles) held responsible for certain malarial (tropical) fevers.

Laveur. (F.) Irrigator.

Law, Angstrom's. The wave-lengths of the light absorbed by a substance are the same as those given off by it when luminous.

Law, Bloch's. See **Bloch, Law of.**

Law, Boudin's. The law of the antagonism of malarial and tubercular disease.

Law, Brewster's. Tangential law. This law declares that for any substance the polarizing angle is equal to that angle of incidence at which the portion of light that is reflected is at right angles to the portion that is refracted.

Law, Colles'. A child that is affected with congenital syphilis, its mother showing no signs of the disease, will not infect its mother.

Law, Descartes'. The sine of the angle of incidence bears a constant relation to the sine of the angle of refraction for two given media.

Law, Donders'. The rotation of the eye around the line of sight is not voluntary; when attention is fixed upon a remote object, the amount of rotation is determined entirely by the angular distance of the object from the median plane and from the horizon.

Law, Giraud-Teulon's. Binocular retinal images are formed at the intersection of the primary and secondary axes of projection.

Law, Gullstrand's. If while the patient is made to turn the head while fixing a distant object the corneal reflex from either eye moves in the direction in which the head is turning, it moves toward the weaker muscle.

Law, Kirchoff's. When a beam of light is passed through a transparent body the latter absorbs only those luminous rays which it is capable of emitting when heated to incandescence.

Law, Listing's. When the eyeball is moved from a resting position, the

rotational angle in the second position is the same as if the eye were turned about a fixed axis perpendicular to the first and second position of the visual line. See, also, **LeConte, Joseph.**

Law, Malus's. In *optics,* the law enunciated in 1808 by E. L. Malus that, an orthotomic system of rays remains orthotomic, no matter what refractions (or reflections) the rays may undergo in traversing a series of isotropic (q. v.) media. An orthotomic system of rays is one for which a surface can be constructed which will cut all the rays at right angles.

Law of absorption. The proportion of transmitted radiation varies geometrically as the thickness of the absorbing medium varies.

Law of decentration. See **Law of Prentice,** and **Decentration.**

Law of direction. See p. 4018, Vol. VI of this *Encyclopedia.*

Law of fatigue (Houghton's). When the same muscle or group of muscles is kept in constant action until fatigue sets in, the total work done, multiplied by the rate of work, is constant.

Law of projection. An impression of any point of the retina is projected outwards into the visual field, following the *line of direction;* that is to say, following a straight line passing through the retinal point and the nodal point of the eye. As long as there is a question only of objects seen distinctly, the law of projection is equivalent to saying that we see exterior objects in the direction in which they really are. See **Physiologic optics.**

Law of reflection. In *optics,* a very ancient law, first mentioned in a work in optics, attributed to Euclid (300 B. C.), that the magnitudes of the angles of incidence and reflection are equal. See also **Angle.**—(C. F. P.)

Law of refraction. In *optics,* the law discovered by Willebrod Snellius (Snell) of Leyden, Holland, who announced it some time prior to 1626, to wit: The sines of the angles of incidence and refraction are in a constant ratio, the value of which depends only upon the nature of the two media which are separated by the refracting surface and on the wave-length of the light. Thus, if the angle of incidence is α and the angle of refraction is β, the law of refraction is expressed by the equation $\sin \alpha / \sin \beta = \eta_{ab}$, which, for light of *prescribed* wave-length, depends only on the nature of the two media designated by the letters a and b, and is called the relative index of refraction from the medium a into the medium b, or the index of refraction of medium b with respect to the medium a. The order in which the subscripts a and b are written indicates the order in which the media are traversed by the light. See, also, **Angle.**—(C. F. P.)

Law of rotations. See **Muscles, Ocular.**

Law of sines. The sine of the angle of incidence is equal to the sine of the angle of reflection multiplied by a constant quantity.

Law, Prentice's. In *optics,* the law enunciated in 1890 by C. F. Prentice that, "any lens is capable of producing as many prisms-dioptries (q. v.) as the lens possesses dioptries of refraction, provided it is decentered one centimeter." See *Archives of Ophthalmology,* Vol. XIX, Nos. 1 and 2, 1890.

Law, Profeta's. A non-syphilitic child born of syphilitic parents is immune.

Laws, Municipal, relating to the eye. See, in this *Encyclopedia,* **Legal relations of ophthalmology,** in the last third of the section.

Law, Snell's or Snellius's. See **Law of refraction.**

Lawson, George. A well-known English ophthalmologist. Born in 1830, his professional experiences began in the Crimea, where he served as military surgeon. Returning to London in 1855, he at once became a surgeon to the Middlesex Hospital—a position which he held for more than thirty-three years. In 1862 he also became Surgeon to the Royal London Ophthalmic Hospital (Moorfields). In 1852 he was made a Member, in 1857 a Fellow, of the Royal College of Surgeons of England. In 1886 he became oculist to Queen Victoria. He died at his home in Harley Street, Oct. 12, 1903, aged 73.

His most important ophthalmologic writings are, "On Sympathetic Ophthalmia" (1865); "Injuries of the Eye, Orbit and Eyelids, their Immediate and Remote Effects" (1867); also "A Manual of Injuries and Diseases of the Eye" (4th ed., 1880).—(T. H. S.)

Lawsonia inermis. The *henna* of Mohammedan countries; the unarmed variety of *Lawsonia alba.* See **Henna.**

Law, Talbot's. When complete fusion occurs and the sensation is uniform, the intensity is the same as would occur were the same amount of light spread uniformly over the disk. (Dorland.)

Law, Wundt-Lamansky's. The law that the line of vision in moving through a vertical plane parallel to the frontal plane moves in straight lines in the vertical and horizontal directions, but in curved paths in all other movements.

Law, Zeune's. The law that the proportion of cases of blindness is less in the temperate than in the frigid zone, and increases in the torrid zone as the equator is approached.

Layard, Daniel Peter. A London physician of the 18th century, who seems to have devoted considerable attention to the eye. He wrote "An Extraordinary Case of Diseased Eye" (*Philos. Trans.,* 1758).—(T. H. S.)

Layer, Bacillary. The outermost but one of the retinal layers; the rod-and-cone layer; Jacob's membrane.

Layer, Bowman's. The uppermost layer of the corneal stroma.

Layer, Bruch's. The inner layer of the choroid coat of the eye: the vitreous lamina. See **Histology of the eye.**

Layer, Ganglion-cell. A layer of the retina between the nerve-fiber layer and the inner molecular layer.

Layer, Kölliker's fibrous. The mesiris; the substantial propria of the iris.

Layer, Molecular. The outer or cortical layer of the cerebral or cerebellar substance; also, a designation of two of the layers of the retina.

Layer, Nerve-fiber. The innermost layer of the retina, excepting the *membrana limitans interna.*

Layer, Pigmentary. The outermost of the ten layers of the retina, and the inner lining of the ciliary organ.

Layer, Sattler's elastic. A thin layer of elastic fibers lying between the large vessel layer and the choriocapillary layer of the choroid of the eye.

Layers, Plexiform. The two molecular layers of the retina.

Lazerme, Jacques. An 18th century physician and surgeon of Montpellier, France, who devoted much attention to the eye. Born at Pouget, diocese of Béziers, in 1676, he received his medical degree at Montpellier in 1703, settled in Montpellier and there succeeded Bézac to the chair of surgery in 1720. He is said to have enjoyed an immense practice. He died in 1756.

He wrote four books, of which the only one of any ophthalmologic importance is entitled "*Curationes Morborum*" (2 vols., Montpellier, 1750; Paris, 1754). In Vol. I of this work is a chapter devoted to ocular therapeutics, which is not without value. The literary style of the chapter is really remarkable for its day and time, being simple, clear, concise, and especially devoid of the useless repetitions so characteristic of many of the contemporaries of this writer. The complicated polypharmacy of the time is also conspicuous by its absence. Lazerme, however, had never appreciated the true nature and location of cataract, in spite of the early experiments of Brisseau and Maître-Jean.—(T. H. S.)

Lazzattin, Pietro. An Italian obstetrician, of a little ophthalmologic importance because of his graduation dissertation entitled "Della Diagnosi della Cataratta e della Scelta del Metodo Operativo." He was born at Milan, received his medical degree at Pavia in 1836, and settled as obstetrician in Milan. In 1863 he was made physician-in-chief to the Milan Lying-in Institution, as well as Professor at the

Royal Obstetrical College, and, a little later, the President of that institution. He died Mar. 22, 1871, aged 57 years.—(T. H. S.)

L. D. Abbreviation for *perception of light difference.*

L. E. Abbreviation of *left eye.*

Lead. *Plumbum.* Lead, in various forms, was a frequent remedy in the hands of ancient Greco-Roman ophthalmologists. Black lead, white lead, burnt lead, and minium were all employed. The chief indications were exophthalmus and any persistent, or especially abundant, ocular discharge.—(T. H. S.)

Lead acetate. PLUMBI ACETAS. NORMAL OR NEUTRAL ACETATE OF LEAD. SUGAR OF LEAD. $Pb\ (C_2H_3O_2)_2+3H_2O$. This salt occurs as shiny, colorless, transparent, tabular prisms having an odor of vinegar and a sweetish, astringent and metallic taste. It is freely soluble in water; less soluble in alcohol. It loses its water of crystallization and becomes translucent at 40° C.

Lead salts are mostly incompatible with the following: acids, sulphates, citrates, tartrates, chlorides, carbonates, alkalies, tannin, salicylic acid, phenol, as well as vegetable infusions and tinctures.

Although most text-books continue to include this agent among the astringents useful in conjunctival diseases, the Editor believes it is about time to drop it from modern lists, especially as we possess so many more potent substitutes. If used at all it should be in very weak solutions, say, ten drops or less of *liq. plumbi subacetatis dilutus* to the fluid ounce of distilled water. All the soluble salts of lead are contra-indicated in abrasions or ulcerations of the cornea owing to the danger of permanent staining from a deposit of plumbic albuminate or other insoluble lead compounds in the lesion-area. A salve of neutral lead acetate in the paraffin ointment of the German pharmacopeia (1:400) is said to be less irritating and more effective than solutions and to be less likely than they to stain the cornea. However, the Editor does not see why we should use any agent likely to leave hurtful sequelæ when other remedies equally effective are at hand.

As an application for the pain of either iritis or glaucoma, R. L. Randolph has much confidence in the so-called Japan "hot-box" with the following, used as a fomentation: Plumbi. acetat., ℥ ii; Pulv. opii, ʒss; Mix with a quart of boiling water. Stephenson advises the use of a one per cent. ointment of the subacetate of lead in follicular conjunctivitis. A small piece is applied to the everted conjunctiva once a day. After two weeks' time the strength of the ointment is doubled, the application being followed by massage. Under this treatment the hyperemia disappears, the discharge is less, the follicles become reduced in size and eventually disappear.

Lead incrustations of the cornea. See p. 3383, Vol. V of this *Encyclopedia.*

Lead poisoning. LEADING. PLUMBISM. SATURNISM. See **Toxic amblyopia.**

Lead water. LIQUOR PLUMBI SUBACETATIS DILUTUS U. S. AQUA PLUMBI P. G. AQUA SATURNINA. Most of these contain about one per cent. of lead subacetate and when made up with alcohol are commonly known as *aqua plumbi Goulardi,* Goulard's lotion or water, just as the stronger solution is known as Goulard's extract.

In Europe this solution is employed as a popular application in compresses, douches, sprays and collyria, but the same objection that applies to other local remedies containing lead acetate (q. v.) also applies to this one; it is likely to permanently stain the transparent cornea in lesions of that organ. Inasmuch as this danger is unknown to the patient, who may develop a corneal ulcer before he consults a medical man, it is best to discourage the popular as well as the professional use of this remedy.

Leaf-like choroiditis. A synonym of diffuse choroiditis. See p. 2141, Vol. III of this *Encyclopedia.*

Learning of vision. LEARNING TO SEE. The processes by which the congenitally blind person learns to appreciate the outside world by means of newly acquired visual powers, as well as the fact that those born blind must *learn to see* after the visual obstruction has been removed, are not always fully understood even by ophthalmologists. George Coats in a review of the paper of Augstein (*Klin. Monatsbl. f. Augenh.,* Vol. LI, ii, p. 521, 1913) remarks that the problem what visual sensations would be experienced by a man receiving his sight in adult life seems first to have attracted the attention of Locke, to whose philosophy the subject was of importance as tending to disprove the doctrine of innate ideas. Augstein seems to be wrong in giving the priority to Bishop Berkeley, whose "*New Theory of Vision*" was published in 1709—after Locke's death—while the "*Essay on the Human Understanding*" appeared in 1690. Both these philosophers dealt with theoretical considerations only. The first observations on a man actually cured were made by Cheselden in 1728. Cheselden's patient "thought all objects whatever touched his eyes" just as things which he felt touched his skin. He used to forget which was the dog, which the cat; "but catching the cat (which he knew by feeling) he was observed to look at her steadfastly, and setting her down, said, 'so Puss! I shall know you another time.' " In more recent times Uhthoff has given a full description of the education of a blind-born child operated upon at the age of seven. The patient could recognize nothing whatever by

sight, but depended at first entirely upon touch or one of the other senses.

Augstein's patient was a lad with bilateral cataract whose left eye was operated upon successfully by discission at the age of 15. For the first week after the bandages were removed he behaved as if he were still blind, ran into objects and guided himself by touch alone. He was but little pleased with his new sense, and could only say that he had a sensation of greater brightness than before the operation. In the fourth and fifth week he began to recognize objects and to walk with more confidence. In the fifth especially he made rapid progress. Having once learnt the appearance of anything, *e. g.*, scissors, a knife, etc.—he could recognize it in any shape or size. He could soon tell a round from a polygonal object, and acquired a good judgment of size and distance, though using only one eye. He showed no surprise at seeing himself in a mirror. At first, apparently, vision was of the tubular type, peripheral vision being a subsequent acquisition. Nystagmus, present before the operation, ceased in about eight weeks, but he continued to have a difficulty in fixing anything for a prolonged period. At first he did not like correcting glasses, but he soon became accustomed to them. Finally, his vision reached 5/50, and he was able to go alone in the street.

Augstein distinguishes three stages in the recovery of vision. At first the functional activity of the retina is almost wholly in abeyance; then its function is recovered and central vision is acquired; finally the periphery of the field of vision expands. In the case of young children with prolonged blepharospasm vision is sometimes "unlearned" and subsequently re-learned through the same three stages. The author considers that the process is not entirely one of brain education, but that the efficiency of the retina as a sense organ is actually improved by practice. He believes that a similar improvement may be observed if the vision of high hypermetropes is watched for a year or two after they have begun to wear their correction.

J. Herbert Fisher (*Ophthal. Review*, p. 161, June, 1914) reports and comments on an analogous case. A girl, æt. 7, had always been quite healthy, but her mother recognized that she was very defective in sight by the time she was six weeks of age. The right was the better eye but there was practically no reflex from the fundus; the pupil was blocked with membrane, and dilated imperfectly, with one large posterior synechia, and the vision was not better than hand shadows. In the left eye there was a dense cataract and some thickening of the lens capsule; no red reflex was obtainable, the pupil was active, and dilated circularly on using a mydriatic; perception of light with this eye was good.

On the 21st of January, 1914, the child being under a general anesthetic, Fisher needled the lens. Immediately a considerable quantity of milky fluid lens material came forward into the anterior chamber; in the centre of the lens there was a fairly large semi-solid portion. Making an incision, he was able to evacuate practically the whole of the lens matter; some of the lens capsule presented in the wound, was picked up with forceps and cut off with iris scissors. A good red reflex could at once be obtained through the pupil. The eye was kept under atropin, and no unfavorable reaction followed the operation. Three days after the operation, on first testing vision—but without correction of the focus,—the child was quite unable to identify any object by the sense of sight, but on calling other senses to her aid she recognized objects promptly and reliably. A week after the operation, on using the ophthalmoscope, a healthy disc and a perfectly natural fundus were easily seen. Rough correction of her refraction was adjusted, and further tests applied. By the sense of sight a penny was not identified, but when it was placed in her hands she was at once able to name it. A small book with a leather cover conveyed nothing through the eyes, but the child called it "leather" when placed in her hands, and, on further handling, identified it as a "book." An ordinary wooden match-box was called a "box" by the sense of touch, and named as a "match-box" when the contents were rattled in her hearing; similarly, a watch presented to her vision gave her obvious pleasure, but what it was was quite beyond her powers until it was put up to her ear, when she immediately called it a "clock." In the dark room she was shown a small medicine glass under the illumination of two electric lights, but she was unable to name it until she handled it; a bright pair of scissors was the only object she tried to name by the sense of sight, and she called it "glass," presumably due to the fact that its bright, reflecting surface recalled to her mind the glass which she had just seen; she knew the object as scissors at once when it was placed in her hand. A pocket-knife with metal handle she could not recognize by sight, and called it "iron" by the sense of touch. About a week later a similar series of tests was again employed under similar conditions in the dark room. It was interesting by now to watch the evident mental efforts which the child made to use her sense of sight, but the results were not very much better than on the previous occasion. The child was quite intelligent, and in the blind school she had attended her other senses had been well trained. On this occasion most of the objects previously employed were again tried, but with very little better result; but now, in her attempt to identify what was shown her, she called several

bright objects "glass," including the scissors. She did not know a cake of soap, but identified it by the sense of smell. A reel of cotton was known by the touch only. She recognized colors with fair readiness; presumably she had sufficient sight in the right eye to appreciate bright color, she had been taught them at school, as she said, "on toy animals." She was able to identify flowers and their color by the unaided sense of sight. By the 18th of February her powers of recognizing objects by sight were decidedly improving; the spectacles provided for her, + 13·D spherical, were now in constant use, and she recognized a watch, also a book and some other objects, but she still made many mistakes unless allowed to use her other senses.

The above corresponds closely with the case described by Uhthoff. Her senses of hearing, smell, and touch had been turned to good account by the training of the blind school she had attended. The difficulties of orientation experienced by Augstein's patient were not a conspicuous feature of Fisher's case, but some allowance has to be made for the very shadowy vision of the right eye in this respect. The patient was at first unable by the sense of sight to guide the hand to grasp an object offered to her; she seemed rather reluctant to make the effort to do so; she may have been deterred by uncertainty whether a pleasant or other sensation would result from contact with the unknown object or by a feeling of incapacity to perform the act asked of her. When she did make the effort her judgments of position and space were certainly very faulty, but, considering her age, perhaps not more faulty than would have been those of an ordinary cataract patient wearing correction for the first time.

In this case Fisher found nothing to support Augstein's view that there are three stages in the recovery of vision, nor could he differentiate between education of the brain and education of the retina. Fisher believes that education both of the end organ and of the centre go on progressively and simultaneously in such cases before the ultimate best use can be made of the new-found sense of sight.

Leash. A bundle of cord-like structures, as nerves, blood-vessels, fibers, etc.

Least circle of aberration. In *optics*, a minimum patch of light projected by a lens upon a screen, and located between the focus of centrally incident rays and the axial intersection of peripheral rays. See also **Aberration.**—(C. F. P.)

Least circle of chromatic aberration. See **Aberration.**

Least circle of confusion. Same as circle of least confusion. See **Astigmatism.**

Lebenskunde. (G.) Biology.

Lebensordungslehre. (G.) Dietetics.

Leber's disease. HEREDITARY OPTIC ATROPHY. NEURITIS OPTICA HEREDITARIA. HEREDITARY CENTRAL RETINITIS (CARGILL). CENTRAL AMBLYOPIA. This interesting hereditary and often familial disease has already been fully discussed on p. 5841, Vol. VIII; as well as under **Amblyopia, Central,** and on p. 5154, Vol. VII of this *Encyclopedia.*

Leber's venous plexus. The venous ciliary plexus about the canal of Schlemm.

Leberthran. (G.) Cod-liver oil.

Lebrun, Pierre Desire. A Belgian ophthalmologist, born at Renlies in 1836. He studied medicine at Lyons, then ophthalmology at Paris and London. He practised at Brussels, dying there Aug. 24, 1900.—(T. H. S.)

Lecithin. OVO-LECITHIN. A phosphorus-containing constituent of the brain substance; artificially derived from yolk of egg. It is a yellowish-white, waxy mass which swells up in water and is soluble in alcohol and fatty oils. In 3 to 8 gr. doses it is used in diabetes and other disturbances of nutrition. It is also given subcutaneously as a 5 per cent. solution in olive oil.

Dewaele (*Belg. Royal Acad. of Med.*, April 27, 1912), described five cases of tobacco amblyopia treated with lecithin and concluded that the treatment quickly brought to the normal those cases recently affected and that chronic cases are rapidly improved, but that progress is arrested at a certain point, probably to the point where actual lesions will not permit of further improvement.

Davis has also treated five cases of tobacco amblyopia after the manner of Dewaele. Three showed some betterment but the results in the series were so variable that no definite conclusions could be drawn as to its value.

Lecithinose. A lecithin from the yolk of eggs: used as a nutrient.

Leclanché's cell. A battery-cell having a carbon collecting plate and employing as a fluid a solution of ammonium chlorid, and as a depolarizer manganese dioxid.

Le Conte, Joseph. Geologist, naturalist, physiologist and philosopher, descendant of an old Huguenot family, was born Feb. 26, 1823, in Liberty County, Georgia. He graduated at the University of Georgia in 1841 at the age of eighteen, and later at the College of Physicians and Surgeons in New York City. He settled in Macon, Ga., and there practised medicine for several years.

In 1850 and 1851 he studied natural history under Agassiz at the Lawrence Scientific School of Harvard, and in the latter year went with Agassiz to Florida on an exploring expedition. Subsequently

he held professorships in Oglethorp College, in the University of Georgia and in the University of South Carolina.

In 1862 and 1863, during the Civil War, he was chemist in the Confederate laboratory for the manufacture of medicines, and in 1864 and 1865 held a similar position is the nitre and mining bureau.

In 1869 he and his brother, John Le Conte, were called to the University of California at Berkeley, Cal., where he occupied the chairs of geology and natural history for thirty-two years until his death.

His first published work was not, as might be expected, one relating to pure science, but to religion; i. e., "*Religion and Science;* A series of Sunday Lectures on the Relation of Natural and Revealed Religion, or the Truths Revealed in Nature and Scripture." It appeared in 1874, and was followed by "*Elements of Geology,*" and in 1881 by "*Sight, An Exposition of the Principles of Monocular and Binocular Vision.*" Later appeared "*A Compend of Geology,*" "*Evolution and Its Relation to Religious Thought,*" and a work on "*Comparative Physiology and Morphology.*" Besides these works he was the author of many papers on animals published in the *Philosophical Magazine; American Journal of Science and Arts,* etc., etc.

To the ophthalmologist, physiologist and psychologist, Le Conte is best known through his volume entitled "*Sight,*" a work widely known and quoted here and abroad as an original authority. It is unique in that it is intelligible, interesting and instructive alike to the general reader and the most advanced specialist. It is remarkable for its lucidity and originality, and as an exposition of scientific method it has never been surpassed. Two-thirds of the work are devoted to the phenomena of binocular vision and the more abstruse points involved therein. Indeed, the phenomena of binocular vision and their elucidation had a peculiar fascination for Le Conte, for, as he states in a preface: ". . . From early childhood I have amused myself by practicing binocular experiments, until I have acquired a facility in voluntary movements of the eyes and in analyzing the visual results which I am sure is quite exceptional."

The development of the whole subject of vision and the wealth of personal drawings illustrating his experiments are eminently independent and original, as are also the experiments themselves. The care and conscientious exactness he took in repeating his experiments, to verify the correctness of every point, are such as only were employed by Donders and Helmholtz, and like many other eminent scientists the simplest apparatus, (more often none at all) sufficed for his purpose.

The parts of *"Sight"* which are most quoted and therefore most familiar to ophthalmologists, are the chapters on the laws of parallel and convergent motion of the eyes, and on the horopter. They are in fact, classics of their kind. Up to the time of their publication, with the exception of some passages in Hering and Meissner, the only work embodying an experimental analysis of the law of Listing [See **Law, Listing's.**] and the form of the horopter, was the *"Physiologische Optik"* of Helmholtz, which beside being difficult German text, is well known to be obscure on these subjects, the argument being based upon an ignorance on the part of Helmholtz of a certain anomaly of adjustment inherent in his own eyes. The whole subject had been thrown into great confusion by the conflicting views of different investigators; nor is it yet uniformly understood by physiologists or its practical value appreciated by ophthalmologists.

Beginning with a lucid description of simple experiments with spectral (after) images, Le Conte demonstrated for the first time by the original device of an experimental plane which could be easily and accurately fixed so as to represent any portion of a spherical surface, that the after-image of a luminous cross was projected without distortion, and truly represents the position of the horizontal and vertical meridians of the retina in all parallel movements of the eyes. He further tested the truth of this by using the sky upon which to project the image, throwing himself flat on his back to get a field for projection downwards. Simple experiments; but unthought of before!

Le Conte was the first to formulate definite laws of convergent ocular motion. The apparatus and method used were likewise entirely original with him and are of routine use in experimental physiology. He first demonstrated clearly true torsion of the eyes in the sense of rotation on the optic axes, finding that in convergence in the primary plane they rotate outward; in convergence above the primary plane that they also rotate outwards contrary to Listing's law, while below the plane the rotation is according to Listing's law but steadily decreases to zero at 45°. With the exception of convergence below the primary plane, the laws which he formulated are probably true only for his own eyes and eyes which, while not abnormal, are anomalous in adjustment compared with eyes which conform strictly to typical conditions.

It was Le Conte who first asserted that Helmholtz's eyes were not normal. Helmholtz's conception of the horopter was based upon Listing's law, and, as Le Conte pointed out, "On his own peculiar views concerning the relation between what he calls the apparent and real vertical meridian of the retina." Helmholtz stated that a perfectly

vertical line appeared to his right eye, not vertical, but inclined $1\frac{1}{4}$ degrees to the left, and to his left eye inclined $1\frac{1}{4}$ degrees to the right. He assumed this to be true for all eyes; a view also held by Hering and other authorities. Le Conte pointed out that for such eyes as Helmholtz's, with the gaze fixed on a distant point on the horizon, the horopter is, as Helmholtz claimed, "the ground on which we stand." Le Conte went farther, and demonstrated the impossibility and inconsistency of Helmholtz's horopter, and found by rigorously careful repetitions of all of Helmholtz's experiments, that only truly vertical lines appeared vertical to his, Le Conte's, eyes; in short, that the vertical meridians of his retinæ, were, unlike those of Helmholtz, truly vertical in the primary position, and even suggested that a permanent condition of outward rotation (cyclophoria, declination), existed in Helmholtz's eyes. Of this there is now no reasonable doubt, since the condition is frequently found by clinoscopic examination to exist in the case of many persons whose eyes are presumably normal.

The findings of the perfected clinoscope, according to Geo. T. Stevens of New York, disprove the laws of convergent motion as given by Le Conte except in convergence below the primary plane. "In perfectly adjusted eyes" (especially those free from anophoria and kataphoria) there is no torsion of either eye. "By means of this instrument it is easy to show that convergence with depression of the line of regard (visual lines), there is a positive or outward leaning of the vertical meridian of each cornea, and that this leaning corresponds with the demands of Listing's law. On the other hand it appears that when the plane of regard is elevated above the primary plane with convergence, the vertical meridians lean toward the median plane." (Which is also in accordance with Listing's law.) "Only in cases of some anomaly of adjustment do these rollings out occur in the primary position."

Dr. Stevens does not give the number of cases or the data upon which he founds these statements, but as he has probably used the clinoscope on a very large number of cases having normally adjusted eyes, presumably his generalization is correct, and that, while Le Conte's eyes were free from declination (i. e., his vertical retinal meridians were vertical in the primary position) there was either excessive rotation upward or downward (anophoria or kataphoria), resulting in real torsion on convergence in the primary plane and above it.

In 1870 Le Conte proposed a new and valuable mode of diagrammatic representation of binocular phenomena, and in "*Sight*" he fully elaborated and illustrated it. The visual diagrams do not, as he states,

"In any case represent the real *visual facts*—i. e., the facts as they really seem to the binocular observer."

The principle involved in this new method is here given because of its importance, and to show the simplicity and lucidness of his experiments.

"If two similar objects be placed before the eyes in the horizontal plane of sight, and separated by a space exactly equal to the interocular space, and the eyes be directed to a distant point so that their axes are parallel and the two visual lines shall pass through the two objects, then both objects will be doubled, the double images of each being separated by an interocular space; and therefore two of the four images—viz., the right-eye image of the right object, and the left-eye image of the left object—will combine to form a *single binocular image in the middle;* while the right-eye image of the left object will be seen to the left, and the left-eye image of the right object to the right. Thus there will be three images seen—a middle binocular image, and two monocular images, one on each side, that on the right side belonging to the left eye alone, and that on the left to the right eye alone. Now, *the eyes themselves are no exception to this law.* In binocular vision the eyes themselves seem each to double—two of the images combining to form *a binocular eye in the middle* (*oeil cyclopienne*)—while the other two are beyond the two images of the nose on either side, and therefore hidden from view. Each eye seems to itself to occupy a central position, while it sees (or would see if the nose were not in the way) its fellow on the other side of the double images of the nose. In other words, in binocular vision, when the optic axes are parallel, as in gazing on a distant object, the *whole field of view, with all its objects, including the parts of the face, is shifted by the right eye a half interocular space to the left, and by the left eye a half interocular space to the right, without altering the relative position of parts.* . . . Many familiar illustrations may be given. If we put our face against a mirror, so that forehead and nose shall touch the glass, and then gaze on vacancy, there will be of course four images of the two eyes in the mirror. Two of these, viz., the right-eye image of the right eye and the left-eye image of the left eye, will unite to form a central binocular eye, and into which our own (binocular eye) seems to gaze. The nose will be seen double and on each side of the central eye, and beyond the double images of the nose on either side will be seen monocular images of the eyes."

Then follows a description and experiments for representing binocular vision in convergence. Had this method always been used, as Le Conte states, "much of the confusion and many of the mistakes to be found in the writings on binocular vision would have been avoided."

As a geologist Le Conte's reputation is deservedly high, and his residence in California in proximity to the Yosemite valley where the phenomena of geology are exhibited on a majestic and impressive scale, was of great advantage to him both as teacher and writer as is shown in his larger work, "*Elements of Geology.*" He had an exalted conception of the scope and purposes of the study of geology. "The Domain of Astronomy," he once wrote, "is space; the domain of Geology is time. . . . Other sciences may deal with time, limited, finite time, but it is the prerogative of Geology alone to deal with infinite time. As Astronomy is limited in time to the present epoch but unlimited in space, so also Geology is limited in space to the surface of our earth, but unlimited in time."

While perhaps best known through his scientific writings, the fact that of the six volumes Le Conte published, the primary motive of two of them was to assert and prove the unity and mutual harmony of natural and revealed religion, justifies some account of them. Not all men are scientific, but "Man is incurably religious," and those who knew him well will agree that to Le Conte religious truth stood first.

In the preface to "*Religion and Science,*" his first published work, he stated that the volume was "the result of an earnest attempt to reconcile the truths revealed in Scripture with those revealed in Nature by one who has, all his active life, been a reverent student of both." He was peculiarly well equipped for the task of reconciling the apparently irreconcilable realms of natural and revealed religion; to shatter the shallow ramparts of modern materialism; for, to the possession of an unusual and accurate knowledge of the laws and phenomena of Nature, he added an intimate and intuitive grasp of the revealed truths of religion. At the very outset he cleared the mental atmosphere of his hearers by defining the generally acknowledged but often overlooked limitations of Science: "Science knows nothing of phenomena which do not take place by secondary causes and processes . . . any phenomenon referred to direct the agency of the First Cause is immediately put beyond the domain of Science. The domain of Science is secondary causes and processes—all that lies between the phenomenon, the object of *sense,* and the First Cause, the object of *faith.* Science passes from sensible phenomena to immediate causes; from these to higher causes, and thus by a continuous chain she rises higher and higher until she approaches the Great First Cause; until she stands before the very throne of God Himself. But there she doffs her robes, she lays down her sceptre and veils her face." Again, "Science cannot remove the incomprehensible, but only increases it. . . . The comprehensible in the midst of the incomprehensible may be likened to a circle of light in the midst of infinite darkness. It is

ever the effort of Science to increase the area of that circle. But, in proportion as we increase the circle of light, do we increase also the *circumference of darkness;* in proportion as we increase the area of the comprehensible, do we increase also the points of contact between the comprehensible and the incomprehensible, and we are therefore more and more penetrated with humility and reverence in the presence of the incomprehensible.''

Repeatedly in the Lectures he asserted the limitation of human reason: ''I must again repeat what I have already said, viz., that there is a mystery in all existence; that *essential* knowledge is not for man, but only *revealed* knowledge. . . . Nature is a pure revelation. Even the existence of external Nature cannot be proved by reason. But, admitting the existence of an external material universe, what matter is we know not, and reason cannot tell us. All we know is, how the material world reveals itself as phenomena. . . . Precisely the same principles apply to the study of the world within. The facts of the spirit world are revealed to us through consciousness. They are ultimate facts, which cannot be proved by reason, but which we always accept by faith. We believe them, but cannot prove them; nor do they need proof, since they are already more certain than anything can be made by proof.''

As to the difficulty of acquiring religious faith, a puzzling yet oft-asked question, like Johannes Müller he thus cut the knot: ''How shall we, then, realize the spirit-world—God, and the immortal soul—as a verity, as we do the material world? I answer, not by thought, or by reason, but by life and activity in that world. How is it in regard to the material world—how do we realize this? By thought and reason? no; by activity. Thought and reason, so far from proving to us the existence of the external world, and helping us to realize it, only teach us to doubt it. . . . So, precisely is it with the spirit world. It is not by thought and reason that the existence of the spiritual world—that those great spiritual truths, God, and immortality, and the fundamental truths of Christianity—can be realized as verities; but by activity, prayerful, loving, helpful activity in the spiritual world. . . . You will doubtless remember the answer of the Divine Master to the carping Jews, asking for a sign to prove the truth of his doctrines. It contains the profoundest philosophy: 'If any man willeth to *do* His will, he shall *know* of the teaching, whether it is of God.' *Do* first and *know* afterward; knowledge comes as the reward of faithful obedience.''

As regards the personality of Le Conte, to those who knew him intimately the man was greater than his works. The leading traits which distinguished him were extreme gentleness, sincere humility, courtesy

and kindness. It is no sentimental exaggeration to state that as a teacher he was not only always listened to with profound interest and profit, but that his students adored him with a personal affection. Firm in his convictions after he had given due thought and experiment to any question, he was never dogmatic, but, on the contrary remarkably tolerant and ready to reconsider his own views in the light of those who differed from him. To find anyone willing to discuss binocular problems with him was a delight, and he would pace the floor, using the pattern of the carpet to illustrate the points as he made them to his companion.

No higher tribute, perhaps, can be paid to his memory than to state this simple truth: That in his daily life, his words and deeds, he practised the Christian truths which he taught so eloquently.

He died July 6, 1901, while on a camping trip in the Yosemite valley, the wonders of which he was for the last time revealing to those who accompanied him. The anniversary of his death is still marked by his old students, who decorate with flowers the desk from which he so long lectured.—(F. B. Eaton.)

Lederhaut. (G.) Sclera.

Ledum palustre. See **Labrador tea.**

Leea sambucina. A shrub found in the East Indian Archipelago, where the juice of the leaves is used as a stomachic, the root to relieve stomach ache, the wood in decoction for thirst, the juice of the branches and the leaves and berries as a febrifuge and as an application to inflamed eyes.

Leech. (Anglo-Saxon, *laece*, "a physician.") This useful animal belongs to the *Hirudinea* or *Discophora*, a class of worm-like animals, usually suctorial parasites, but sometimes genuinely carnivorous. They are widely distributed in fresh and salt water, and occasionally on land. The body is extensile and ringed, but the superficial rings do not correspond to the true segments; no appendages are present, but there is a posterior attaching sucker, and the mouth is powerfully suctorial; the body-cavity is almost obliterated by a spongy growth of connective tissue; the animals are hermaphrodite.

The medicinal leech (*Hirudo medicinalis*), formerly much used in blood-letting, has a slightly flattened body 2 or 3 inches in length, greenish-black in color, mottled on the under side, and with six rows of reddish and yellowish spots along the back. (See p. 2544, Vol. IV of this *Encyclopedia.*) The skin is slimy and frequently casts its cuticle; there are 102 superficial skin-rings, with sense-spots on every fifth, while ten distinct eye-spots are borne on the head. The mouth contains three semicircular "saws," each with eighty to ninety minute teeth of lime and chitine, by the saw-like action of which the leech

gives its characteristic triradiate bite. From animals thus bitten the leech sucks blood, and falls off when its many-pouched gut is gorged. A secretion from the pharynx seems to keep the blood from coagulating, and after a heavy meal the leech can fast and digest for a year. About the leech's own blood, it is worth noting that it is colored red with hemoglobin. The eggs are laid about June in the moist ground by the side of the water, and are enclosed in cocoons which are secreted from the skin. The growth of the young leech is slow, may continue in fact for four or five years, while the total length of life sometimes reaches a score. When the medical use of leeches, which is of ancient origin, was a constant practice, the swamps of western France were very important sources of supply. It is calculated that thirty millions used to be employed annually for medical purposes in France and England, but nowadays they have gone much out of fashion.

Natural Leech.

The most common species in the United States belong to the genera *Nephelis* and *Glossiphonia* (or *Clepsine.*)—(*Standard Encyclopedia.*)

The *therapeutic indication for leeching,* as well as its method of application are fully discussed on p. 1226, Vol. II of this *Encyclopedia.*

Leeches have been observed by Carron du Villard in Havana and by Amat in Algiers to have bitten the caruncle and to have attached themselves to the upper folds of transmission. Whether the animal was *Hirudo officinalis* or *Hæmopis vorax* (horse-leech) is not clear from the evidence.

Leech bite of the cornea has been observed by E. B. Coburn (*Ophthalmic Record,* May, 1911). As a result of the trauma the patient had only eccentric vision and ability to count fingers at one foot with the right eye. There was a crater-shaped depression in the center of the cornea with a dense central opacity which had a slight resemblance to the characteristic mark left by the bite of a leech. There was a smaller area surrounded by a circular zone of dense white opacity which marked the outer boundary of the craters that involved almost the entire cornea, except the external portion, through which the iris could be seen. The pupil was scarcely visible. The tension of the eye was normal. There were slight circumcorneal injection and photophobia. The patient gave the history of being bitten in the eye by a leech after bathing in a river. As the patient was a Russian the

injury may have been inflicted for the purpose of escaping military service. Such injuries are described by Seidenmann as inflicted for that purpose in that country.

Leech, Artificial. See p. 633 Vol. I of this *Encyclopedia.*

Leech-bite of the eye. See **Leech.**

Leeching. See **Blood-letting, Local**; also, **Leech.**

Leek. *Allium porrum.* The frequent use of leeks as an article of diet was supposed, in ancient Greco-Roman times, to produce a weakening of the sight. On the other hand, the juice was employed as a local application to stimulate the growth of cilia.—(T. H. S.)

Leeuwenhoeck (or Leuwenhoek), Anton van. First a mechanic, later a famous physician and microscopist, Leeuwenhoeck was born at Delft, Holland, in 1632, and died at the age of 91. He was the first to employ the microscope on the tissues of the eye. The layer of rods of the retina, the fibres of the lens and the cornea, and the epithelial layer of the latter membrane were all discovered by him. Leeuwenhoeck also, in 1690, discovered the capillary circulation, an event which made complete the work of Harvey.—(T. H. S.)

Lefebvre, Guillaume-René. A French physician, historian, all round man of letters, and ophthalmologic quack. Born Sept. 25, 1744, at Saint-Croix-sur-Orne, he became successively soldier, doctor, etc. He held a number of official positions in his native land, fled therefrom in 1790, and traveled in Holland, Germany, Italy, Turkey and Egypt—wherever, in short, there were "fools and money that needed separation." He wrote "Traité de la Paralysie du Nerf Optique," "Mémoire Theoretique et Pratique sur l'Ophthalmie" (Frankfort-on-the-Main, 1802); "Sichere und Kurze Heilart aller Augen-Entzündungen" (1802), "Histoire Anatomique, Physiologique, et Optique de l'Oeil" (Frankfort, Strassburg and Paris, 1803). "Black Cataract" he professed to cure by means of a stream of hydrogen gas directed against the eyeball. In 1809 he was practising in Augsburg, Germany, where he had become physician-in-chief to the hospitals. He died of typhus fever, July 27, of the same year.—(T. H. S.)

Le Fort's operation. A method of transplantation of flaps comprising the whole thickness of the skin without the subcutaneous fat.

Left diplopia. Vertical diplopia in which the image perceived by the left eye is below.

Left eyedness. A condition in which, even if central sight is the same (or almost the same) in each eye and there is no strabismus, the tendency is to use the left eye for distinct vision. George M. Gould has described and discussed this matter. See, *inter alia, Mind,* Vol. IX, p. 93, 1884.

Legal relations of ophthalmology,[1] **The.** OPHTHALMIC JURISPRUDENCE. Inasmuch as the subject of ophthalmic jurisprudence is very comprehensive and also somewhat intricate, the following outline of the contents of this article is offered in the hope that it may serve as a guide through the ophthalmo-jurisprudential labyrinth.

I. INTRODUCTION: Court Systems and Basic Legal Principles in America, England, France, Germany, and Italy.

II. OPHTHALMIC EXPERT TESTIMONY.

  A. Legal Considerations in America, England, France, Germany, and Italy.

  B. Medical and Surgical Considerations.

    Commonest Injuries with which the Ophthalmic Expert has to Deal.

    Simulation of Ocular Injury or Disease.

    False Attribution of Ocular Injury or Disease.

    Exaggeration.

    Dissimulation.

    Visual Economics.

    Questions of a General Nature Relating to the Power of Vision.

    Condition of the Eye after Death.

    Ocular Signs of Sleep.

    Ocular Indications of Poisoning, Burning, etc.

    Ocular Signs of Identity.

III. OPHTHALMO-SANITARY LEGISLATION IN THE FIVE COUNTRIES: Ophthalmia Neonatorum, Optometry, School Inspection, Vaccination, etc.[2]

IV. MALPRACTICE.

  A. Legal Considerations in America, England, France, Germany, and Italy.

  B. Medical and Surgical Considerations.

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[1] So far as the Editor knows, Dr. Shastid's chapter in Wood's "*System of Ophthalmic Operations*" (Chicago, 1911), which appeared beneath the caption, "The Forensic Relations of Ophthalmic Surgery," and which forms the basis of the present article, was the earliest attempt in any language to render a systematic account of the law relating to our special subject. The Editor does not, of course, ignore the numerous, and now and then important, monographs which had dealt with the various minor aspects of ophthalmic jurisprudence. The chapter in question, considerably epitomized and brought to date, appeared in Ball's "*Modern Ophthalmology*" (Phila., 1913) and was there entitled "The Legal Relations of Ophthalmology." The present article also bears that title, but the matter has been again revised as well as very much enlarged.—Ed.

[2] The ophthalmo-sanitary heads are all considered in this article chiefly as a means of preserving this (the major) article's continuity, and, therefore, in each instance are given as a kind of abstract. For a fuller consideration, in each case, see **Conservation of vision**; as well as **Care of the eyes.**

I.

Introduction: Court systems and basic legal principles in America, England, France, Germany, and Italy.

In order to comprehend the laws relating to medical experts, the laws on which the science of visual economics and the like depends, and especially the laws relating to medical and surgical malpractice, either in this or in any other land, it is first of all essential to comprehend the system of courts in the countries whose laws are under consideration, and also certain fundamental legal principles, without a knowledge of which no individual laws whatever can be really understood. Nor is this task so formidable as it might at first appear. Comparative jurisprudence, though a realm of almost infinite extent,[1] nevertheless exhibits for its prominent characteristics certain very simple matters, which can easily be stated and easily be understood. And only these featural affairs, these salient characteristics, will here be attempted.

Court Systems and Basic Legal Principles in the United States.

To take our own country first, because it is the nearest and because its judicial system, though the most difficult, is already partly known to us. In the United States two entirely distinct judicial systems are daily operating, as it were side by side—the federal and the state. The federal courts exist by the authority of the federal constitution—the constitution of the United States of America—and the state courts by the authority of the constitutions of the various separate states—Texas, New York, Illinois, etc. The federal courts interpret, apply, and enforce the constitution of the United States, the statutes which have been passed by Congress, and, under many circumstances, the constitutions and statutes of the several states. They do not, however, as a rule, enforce any former judicial decisions either of themselves or of the state courts. There is, in other words, no federal "common law."[2] State courts, on the other hand, interpret, apply, and enforce their own constitutions, the statutes of their own legislatures,

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[1] So vast, in fact, is the field of comparative law, that only a little (to speak relatively) has ever been done to develop it.

[2] For example, in the case of Wheaton v. Peters (8 Peters 591, 1831), the Court declared: "It is clear there can be no common law of the United States. The Federal Government is composed of states; each of which may have its local usages, customs, and common law. There is no principle which pervades the Union and has the authority of law; that is not embodied in the constitution or laws of the Union. The common law could be made a part of our federal system, only by legislative adoption." Even in matters of procedure there is no federal case law. Thus Dwyer, "*Law and Procedure of U. S. Courts,*" p. 320: "In *law* cases, the Federal courts follow the *procedure* of the states; but in *equity,* the old chancery procedure is followed except where Congress has modified or changed the old rules."

and the various judicial decisions which have been rendered in former cases by themselves.

Now, exactly what courts are those which go to constitute the so-called "federal" system, and what, in the case of each, is its jurisdiction? The federal courts consist (excluding certain tribunals whose existence is here irrelevant even for purposes of clearness, such as the interstate commerce commission, the consular courts, etc.) first, of the district courts,[1] then of the circuit court of appeals, and, finally, of the Supreme Court of the United States.

The federal *district courts* have original jurisdiction only, excepting appellate jurisdiction (i. e., from the judgments and orders of United States commissioners) under Chinese-exclusion laws and over the Yellowstone National Park. Their authority extends (as well as to many other matters here irrelevant) to "all cases of admiralty and maritime jurisdiction," to "all crimes and offenses cognizable under the authority of the United States," to "all cases arising under the postal laws," and to "all suits brought by any person to recover damages for any injury to his person . . . or property on account of any act done by him, under any law of the United States, for the protection or collection of any of the revenues thereof." In all of these matters, as will be readily observed, the assistance of the medical expert witness is frequently required for the untying of lego-medical knots. Then again, the federal district courts have jurisdiction over "all suits of a civil nature, at common law or in equity, brought by the United States, or any other officer thereof authorized by law to sue, or between citizens of the same State claiming lands under grants from different states; *or, where the matter in controversy exceeds, exclusive of interest and costs, the sum or value of three thousand dollars,* and (a) arises under the Constitution or laws of the United States, or treaties made, or which shall be made, under their authority, *or* (b) *is between citizens of different States, or* (c) *is between citizens of a State and foreign States, citizens, or subjects."* The specially relevant passages have been italicized by the present writer, and it is easy to perceive from these passages that, in suits of a civil nature for personal injuries, where the matter in controversy exceeds, exclusive of interests and costs, the sum or value of three thousand dollars, and

[1] It may not be amiss to suggest that there are several federal district courts (no district, by the way, transgressing a state boundary) in almost every state. The United States circuit courts, which had been in existence for more than a hundred and twenty years, were abolished by "The Judicial Code" of Mar. 3, 1911, and all of their jurisdiction, as well as their "pending labors," was transferred to the federal district courts, which, in addition, kept all the jurisdiction which they had had before the passage of that Code.

where such suit is between citizens of different States, or between citizens of a State and foreign States, citizens and subjects, a physician may be required to appear either in his quality of expert witness or in that of defendant in a malpractice suit. It is specially to be noted that a physician cannot be sued for malpractice in a United States court (contrary, of course, in a State court) unless the requirement of diverse citizenship between his plaintiff and himself shall truly exist and appear in the pleadings, and also unless the amount that is sued for shall, exclusive of interest and costs, exceed the sum or value of three thousand dollars.

The *circuit court of appeals* has appellate jurisdiction only. Physicians, therefore, have no occasion to appear before this court.

The jurisdiction of the *Supreme Court* of the United States is thus expressed by the federal constitution:[1] "In all cases affecting ambassadors, other public ministers and consuls, and those in which a state shall be a party, the Supreme Court shall have original jurisdiction, and in all other cases . . . appellate jurisdiction . . ." So far as this court possesses original jurisdiction, it may, of course, require the attendance of expert (as well as of ordinary) witnesses.

Thus much for the federal system of courts; now for the systems, or sets, of courts which exist in the separate states and which operate by virtue of the authority conferred upon them by the various state constitutions. These state systems differ a little in the different states, but in the state of Illinois for example, they are, briefly: the coroners' courts, the courts of justices of the peace, the county courts, the circuit courts, the appellate courts, the city courts (simply auxiliary circuit courts) and the Supreme Court.[2]

As defendant in a malpractice suit, the physician or surgeon (including, of course, the ophthalmic surgeon) may be cited to appear in the circuit court, or, indeed, if the amount sued for be small enough, in the county court.[3] If either of the parties appeals from the circuit court (in which tribunal the suit is nearly always brought) he goes to the appellate, and later, if the matter is taken still farther, to the Supreme Court.

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[1] Art. III, Sec. 2, par. 2.

[2] In New York and Kentucky the "Supreme" Court is not really supreme. In each of these states, the highest court is the Court of Appeals, while the so-called "Supreme" Court ranks next beneath.

I have not seen fit to set down in anything resembling a comprehensive manner the various jurisdictions of the different state courts, though I made an approach to this in the case of the federal system; the reason being that nearly every citizen has a fair idea of the jurisdictional field pertaining to the courts of his own state; though a hazy one indeed with respect to the competence of the courts of the United States.

[3] Only, however, in counties in which separate probate courts have been established.

As expert witness, the physician or surgeon (including, of course, the ophthalmic surgeon) may be summoned to the coroner's court, the court of a justice of the peace, to the county court, to the circuit court, and, sometimes, to the Supreme Court, i. e., in cases where this tribunal possesses original jurisdiction. He never appears, however, before the Appellate Court, because the competency of this court is limited exclusively to appeals. In the coroner's court his function is restricted to assisting the coroner's jury in arriving at a verdict as to the probable cause of death.[1] In the justice's court, his office is frequently to decide as to whether a certain injury is severe or only slight, or whether it is likely to prove fatal or not; for, on matters such as these, sometimes, in criminal cases, depends the defendant's right to bail. In this court, also, as well as in the county court, the medical or surgical expert not infrequently gives evidence on various other matters. In the circuit court, finally, his evidence is as wide as the broad field of medicine.

It is to the circuit court, well nigh always, that the ophthalmic surgeon is called as an expert witness.

An interesting matter presents itself at this point: What is the line of demarcation separating the jurisdiction of the federal system of courts, taken altogether, on the one hand, from that of the various state systems, or sets, of courts, taken altogether, on the other? Territorially, of course, the jurisdiction is nearly the same in each instance—state courts, to be sure, being wholly devoid of authority over the high seas, over the District of Columbia, etc.—but what about subject-matter? Just what kinds of cases, in other words, are triable in the federal system and what kinds in a state system? Says the federal constitution:[2] "The judicial power of the United States shall extend to all cases, in law and equity, arising under this constitution, the laws of the United States, and treaties made, or which shall be made, under their authority; to all cases affecting ambassadors, other public ministers or consuls; to all cases of admiralty and maritime jurisdiction; to controversies to which the United States shall be a party; to controversies between two or more states; between a state and citizens of another state, between citizens of different states, between citizens of

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[1] The office of coroner was abolished in Massachusetts in 1877, and that of "medical examiner" created in its stead. In case the medical examiners (who must be registered physicians) decide that the death in question was due to violence, they so report to the district attorney and to a justice of the district. Similar changes have been made in Michigan, Rhode Island and Connecticut. See "The Office of Coroner," by R. B. H. Gradwohl, M. D., St. Louis, in the *Journal of the American Medical Association,* Mar. 12, 1910, Vol. LIV, No. 11, p. 842.

[2] Sec. 2, Art. III. The section is given here in full, though partly irrelevant otherwise to present purposes, for the sake of clearness.

the same state claiming lands under grants of different states, and between a state, or the citizens thereof, and foreign states, citizens, or subjects." This grant of jurisdiction by the separate states to the federal government leaves all other jurisdiction whatsoever in the hands of the separate states. The practical results, however, are just a little different from that. Says Dwyer: [1] "In fact, many cases within the reach of the judicial power of the federal government are left wholly to the state courts; in other cases the courts of the United States have exclusive jurisdiction; while in others, the state courts are permitted to exercise a jurisdiction concurrent with the federal courts."

It happens, though very rarely, that actual conflict takes place between the jurisdiction of the federal and that of the state courts. What system, in such circumstances, has the actual cognizance of the particular case at bar? Here, again, the federal constitution speaks: [2] "This Constitution, and the laws of the United States which shall be made in pursuance thereof, and all treaties made, or which shall be made, under the authority of the United States, shall be the supreme law of the land; and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding." Thus, therefore, in case of actual conflict, the federal law is supreme. *But there must be actual conflict.* Within its own proper classes of cases, the law of any state is as absolutely paramount as is that of the United States within its proper classes of cases.[3]

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[1] "*Law and Procedure of U. S. Courts,*" Ann Arbor, Mich., 1901, p. 63.

[2] Art. VI, par. 2.

[3] If anyone should think the legal preliminaries to this article unnecessarily long, I would offer as my excuse the fact that works on legal medicine contain, as a rule, extremely little information on the important subject of courts and fundamental legal principles (these matters being continually assumed to be understood) and that, as a consequence, such information is not, as a rule, very accessible to doctors, while, as already stated, a little of such knowledge is absolutely essential to even a fair comprehension of the individual statutes and rules with regard to expert witnesses, economics, malpractice, etc. Just to illustrate in connection with the matter to which this note is appended: Not long since, a physician of excellent education and wide reading, having been threatened with a suit for malpractice in an Illinois court, had found in a widely-circulated work on legal medicine a case which had been decided by a federal court and which seemed to him to militate against his interests. He declared excitedly that, though the law in Illinois was greatly in his favor, yet that the federal law would, being higher, set aside the law of Illinois, and thus destroy his prospects in the case. He was absolutely amazed to learn that the federal decision had no authority whatever in an Illinois court, so long as the latter tribunal was acting within its jurisdiction and so long as it possessed on the point in question decisions of its own. Had it had no decision of its own, then (as will appear hereafter) the federal case would have taken on persuasive (not binding) authority, the same precisely as would the decision of any court of last resort in any judicially influential state with regard to the same question. Even had the plaintiff been a citizen of another state than that in which the doctor in question had his citizenship, and had the amount involved exceeded the "sum or value" of three (at that time, two) thousand dollars, and had the plaintiff, taking advantage of these

So much for American courts, and, briefly, the power which each of them possesses. There remains, however, a very important piece of legal machinery to be considered in connection with the most of these courts—namely, the jury. In the coroner's court, a jury—which can never be dispensed with—consists of six men. In a court of a justice of the peace there is generally no jury, but "either party may have the cause tried by a jury if he shall so demand before the trial is entered upon, and will first pay the fees of the jurors."[1] When, in a justice's court, a trial is had by jury, the body consists (in Illinois, for example) of "six, or any greater number not exceeding twelve, as either party may desire."[2] A jury (not always had) in the county court, consists of twelve men, unless the parties elect to reduce the number to six. In the circuit court there are two kinds of juries—the grand jury and the petit jury. The grand jury is a sort of inquisitorial, or provisional, tribunal, consisting of not less than twelve men or more than twenty-three, whose duty it is, in private session, to examine into various matters of a criminal nature, either on their own motion or that of a public prosecutor, and, in case they deem it proper so to do, to present to the circuit court a formal, written accusation, or "indictment." The petit jury, in a circuit court, consists of twelve men. Its duty, like that of a jury in any other court, is, generally speaking, to decide upon the facts, while the function of the judge is, speaking generally again, to determine points of law. In the circuit court, a trial is almost always had by jury (except in chancery cases, and sometimes even then). The decision of a jury is called a "verdict." The conclusion of the judge (which, in a jury trial, is of course based upon the verdict) is known as the "judgment."[3] In any petit jury, a unanimous vote is absolutely necessary to constitute a verdict, both in civil and in criminal cases. In a grand jury, a majority vote is sufficient if it amounts to twelve.

Trial by jury is a normal, and a very important, part of that great

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facts, actually brought her suit in a federal court, then, even then, the action, although in a federal court, would not have been subject to federal common law—for, as above stated, there is no federal common law. The case would have been decided, so far as possible, under the statutes of the state. Outside of those statutes (and the interpretations of them made by the courts of last resort within that state) neither the decisions of the state nor any federal decisions would have had the slightest binding power upon the court—which would simply have decided "in accordance with the principles of general jurisprudence." One can read and re-read individual laws without the slightest actual understanding of them, unless he comprehends in advance a few fundamental matters, such as those which are stated in this Introduction.

[1] Hurd's "*Revised Statutes*" *of Illinois*, 1909, Chap. 79, Sec. 48.

[2] *Loc. cit.*

[3] For a detailed and scholarly study of judgments in general, see Rood's "*Attachments, Garnishments, Judgments and Executions*," (8 vo., Ann Arbor, 1901).

division of the legal systems of civilized countries which is known as the Common Law—i. e., the legal systems of England, and the various lands—Australia, Canada, the United States, etc.—that have taken their basic legal views from that country. It is not normally a constituent of the other grand division, or class, of legal systems—i. e., those derived from the civil (ancient Roman) law, and to which belong the legal systems of practically all the countries of continental Europe.[1] However, as we shall later observe, the jury has, to some extent, owing to the influence of the English legal system on the Continental system, been introduced into the judicial machinery of Germany, France, Italy, and even of some other continental lands.

The importance of this little body of often illiterate men, for the parties, for the judges, and for expert witnesses, can hardly be exaggerated. In common law countries, for example, in which the jury trial is so conspicuous a feature, it has given rise to an extensive and complicated branch of the law, which is known as the Law of Evidence—a body of rules relating to what may, and what may not, be presented to the jury. This great branch of the law, it would seem, does not possess an independent existence (or none worth mentioning) in any of the civil law countries. On the jury it is, almost always, that the medical expert witness is required to shed his scientific light. To the jury it is, moreover, that, when a doctor appears as defendant in a suit for medical or surgical malpractice, his case is practically handed over for its entire decision. Indeed in Illinois, and, I believe, in certain other of the American States, the jury is made, for weal or for woe, sole arbiter not only of the facts but of the law.[2]

Great, therefore, is the jury in the various Common Law systems. Of little importance, however, is that body of men in the systems which have descended from the jurisprudence of ancient Rome.[3] The duties of a medical expert witness, accordingly, are somewhat different in common law, from what they are in civil law, countries.[4] In the for-

1 One of the most remarkable facts of human history is this strange, this well-nigh inexplicable vitality of the ancient Roman law. That a system of jurisprudence developed in a state of society in every way so different from that of modern Europe, should persist through all the centuries and be found still applicable, is an almost miraculous occurrence. But the Romans seem to have constructed their jurisprudence as they built their roads—to last forever.

2 Under instructions from the judge, of course.

3 Juries were had, in ancient times, undoubtedly, both in Rome and in Greece. But these (the so-called *judices* and the *dicastæ*) were not the sources of the modern petty jury, which, as declared by Jenks (*A Short History of English Law*, p. 333) "was a mere after-thought, designed to fill the gap left by the abolition of the ordeal." This "after-thought" occurred about A. D. 1300.

4 A fact too often lost sight of by those who propose reforms in the medical expert systems of the United States—reforms suggested, in very many instances, by the successful operation of medical expert corps to be found, here and there, among civil law countries (France and Germany, for instance, not Italy).

mer, for instance, the functionary in question addresses the jury, in the latter, the judge. In a common law land, he directs his remarks (generally speaking) to a body of mentally untrained men, incapable of complex reasoning, or, in other words, of winnowing testimony, for themselves, and hence he is bound to submit to a multitude of rules respecting what is, and what is not, "proper to go before the jury." In a civil law land, on the other hand, he addresses the judge, or, it may be, a benchful of judges, who are nearly always highly trained logicians, and, for that reason, he is wholly unhampered by our truly astounding "rules of evidence."

Now, what kinds of law do American courts—acting, to be sure, very often in conjunction with their juries—interpret, apply, and enforce? and, moreover, what are the rules, or principles, according to which are made these interpretations, these applications, these enforcements?

We have already seen that, in the federal courts, the laws applied are, chiefly: the federal constitution, the acts of Congress, and (under many circumstances) the constitutions and statutes of the several states, as well as "the general principles of jurisprudence;" that, in a state court-system, they are: the constitution of the particular state in question, the statutes passed by the legislature of that state, and, finally, the decisions of these same courts in former cases.[1] Now, in each instance— either in the federal system or in any given state system—the question, of course, arises: which of these kinds of law is of the higher force and effect? In other words, when a conflict arises betwixt constitution, statutes, and case-law (otherwise known as the common law, the judge-made law, and the unwritten [2] law) which kind of law is held to supersede the other kinds? The invariable rule is that the common, or case, law is the lowest form of law, and must give way, in case of conflict, to statutory enactment, and that both statutory enactment and case-law are controlled by the constitution. Of course, multitudes of decisions accumulate, in the course of the application of

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[1] It should, of course, be understood that, in any jurisdiction, it is only the decisions of "courts of last resort" which constitute law for subsequent cases. The doctrine that the decisions of courts of last resort take on the force of law for subsequent cases in courts of any grade, is known as the doctrine of *stare decisis* (to stand, or abide, by decided cases). This doctrine prevails in England and in all the various countries which have derived their legal system from that land—Canada, the U. S., etc. In civil law countries (*i. e.*, countries whose legal principles were, as already stated, adopted chiefly from the ancient Romans—as France, Germany, Italy) the doctrine does not prevail. A judge may, if he choose, in those countries, apply the law in one way today and in another way tomorrow. This, at least, is the theory. As a matter of fact, however, a judge in a civil law country is very much guided by former decisions.

[2] Because, originally, in ancient times in England, the decisions of courts were neither printed nor written, but merely preserved in men's memories.

statutes and of constitution, and these decisions become, as it were, a part—and a very important one—of the constitution or of the particular statute which is under consideration. They, too, are a part of the law.

Again, certain rules exist for the application of case-law, or common law, at least some of which must be understood before the "legal relations" of anything whatever can be even slightly comprehended. The most important of these rules are:

1. A case of "first impression"—i. e., a pioneer case or a case which, for the first time in a court of last resort in the given jurisdiction brings up directly for decision the matter in question, does not possess so binding a force as law as do subsequent cases holding to the same effect; and, in general,

2. An old case, if others things are equal, does not possess so high an authority as one more recent.

3. Whatever is said in a case that is not strictly necessary to the decision of that case, does not take on the force of law for subsequent cases, but is only *obiter dicta*—i. e., "sayings by the way."

4. The decision of a court of last resort in any other state than that in which a case arises, has no compulsory force as law, but "persuasive authority" only—an authority which, moreover, is greater or less according (among other matters) to the eminence of the court of last resort which rendered the decision applied to. Thus, the decisions of the Supreme Court, still more the Court of Appeal, of the State of New York have always been possessed of much "persuasive authority" in the courts of other states. The same is true of the Supreme Court of New Hampshire, and of some other states.

5. A scanty, ill-reasoned opinion is of less force than a full and cogent one.

Two great divisions of the law of any country, which are absolutely necessary to be understood, may here most conveniently be discussed, though with special reference to American law—the *criminal law* and the *civil*[1] *law*.

The *criminal law* is that division of the law which relates to crimes, and a *crime* is any act or omission regarded by the legislative power as being so injurious to the general public that the government itself will punish the person or persons who are shown to be responsible for such act or omission. Any proceeding which has for its object

[1] The term, "civil law," it is well enough to notice, is employed here, as elsewhere in legal writings, in two widely differing senses. In the first acceptation it denotes the various legal systems descended from the *corpus juris civilis* of ancient Rome—as those of France, Germany and Italy. In the other sense, it signifies the *non-criminal* portion of the law of any country.

the infliction of this punishment is called a *criminal action,* or, more briefly, a *prosecution.* Crimes are of three grades, *misdemeanors, felonies,* and *capital crimes.* A *misdemeanor* is any crime inferior to a felony. A *felony* is a crime punishable by imprisonment in the penitentiary. A *capital offense* is any offense punishable by death.[1]

The *civil law* is simply the non-criminal portion of the law.

In criminal actions, or prosecutions, physicians are not infrequently summoned as expert witnesses, to assist in the unravelling of various medical or surgical tangles, especially in connection with the offenses specifically known as murder, rape, mayhem (mutilation), etc. In actions of this sort, however, the ophthalmic surgeon is naturally enough very seldom asked to lend to the jury the assistance of his knowledge and skill. It is the general practitioner that is almost always appealed to. In civil cases, however, especially in that variety known as personal injury suits (including, of course, the sub-variety known as malpractice actions) the ophthalmic surgeon is frequently subpœnaed to explain to the jury the nature of various injuries to the eye, or diseases of that organ, or of the probable extent and economic value of the disability produced by such diseases and injuries.

In connection with this matter of personal injury actions, we have to remark that these are brought invariably for the purpose of securing what is technically known as "damages"—i. e., *monetary compensation* for a damage—and that damages are of three very simple classes, or varieties: *nominal* damages, *compensatory* or *substantial* damages, and *punitive, vindictive,* or *exemplary* damages.

Nominal damages are awarded when there is a mere technical violation of a right, but no actual damage. The amount of nominal damages awarded in any given case is often very small—six cents, sometimes one cent. Such a judgment, however, throws, as a rule, the costs of the suit upon the defendant. On the other hand, in certain jurisdictions a judgment, to "carry costs," must be for "substantial" damages.

Substantial or *compensatory* damages are allowed when there is not merely a technical violation of a right, but also an actual damage, or injury. In the estimate of such damages, matters such as the following may be taken into consideration: (1) Necessary and reasonable

[1] Various definitions of some of these terms prevail in various jurisdictions, the consequence of which is confusion. The chief differences occur with regard to the word *misdemeanor.* The definitions above given are the simplest, and, possibly, as correct as any that could be stated for a general understanding. They are, moreover, those recognized by the present-day law of England. Thus, Russell, "*Law of Crimes,*" 1910, p. 10: "The word *misdemeanor* is applied to all offenses (whether at common law or by statute) which are below the degree of felony, whether they are punishable on indictment or on summary conviction."

expenses, as hospital fees, nurses' and doctors' bills; (2) loss of time; (3) pain and suffering; (4) disfigurement; (5) reduction of the earning capacity. It not infrequently happens that this last-named item constitutes by far the most important feature of the bill; hence the significance which attaches to the subject of "Visual Economics"[1]—i. e., the methods whereby can be correctly estimated the loss of earning power directly[2] consequent on the various injuries and disease of the eye.

Punitive, exemplary, or *vindictive* damages may be recovered—in certain jurisdictions only, and these not many—when the damage was inflicted under aggravating circumstances. This kind of damages exceeds the allowance which could be made for mere compensation, adding, as it does, thereto, a larger or smaller sum by way of punishment, or vengeance, in order, as it were, to make an example of the defendant.

These various sorts of damages can thus be briefly illustrated: A commits an assault and battery on B, but without inflicting on him any material damage. B sues A, and is simply awarded a cent in recognition of his right to freedom from assault and battery. In some jurisdictions, B, under these circumstances, would have to pay the costs of the suit, as well as the one-cent damages; while, in others, the costs would have to be borne by A.

Now, suppose that A has inflicted on B a very material injury; has, for example, knocked out one of his eyes. B can recover substantial damages, the amount to be determined by adding together the various estimated values of such items as pain and suffering, doctors' bills, loss of earning capacity, etc., as heretofore stated.

But, once more, suppose that A put out the eye of B under especially exasperating circumstances; for instance, with the declaration that he destroyed the sight of the eye merely in order to render B incapable of earning a living, or of marrying a certain person, or "simply to see what the inside of it looked like." Here, in a few (a very few)

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[1] To be treated some distance *infra.*

[2] It may not be amiss to state explicitly that any damage, in order to constitute a ground for a suit for damages, must be a *direct,* not an indirect, result of the wrongful act, or, as it is often expressed, the result of a proximate, not a remote, cause. To express the matter still differently, the "damage must be the legitimate sequence of the thing amiss." An excellent example of this principle is furnished by the leading case of Scott v. Shepherd, in which it appeared that the defendant had thrown into a crowd a lighted squib. One after another of those in the crowd struck at the squib to keep it from impinging on their faces, until, at last, "it had burnt out the plaintiff's eye." The defendant pleaded that the damage was indirect, insomuch as it was really due to "the subsequent acts of others." But the court held that the acts of the others were "instinctive and innocent," and such as should have been foreseen by ordinary forecast, and that the act of the plaintiff, therefore, was the direct cause of the damage.

jurisdictions, the defendant would be entitled to damages in excess of those which could be considered as legal compensation.[1]

Excessive damages. This is still another term which we need to understand. The amount of damages which a jury has a right to assess is not unlimited, and, in case it assesses, or estimates, the amount at an unreasonably high figure, the damages are said to be "excessive." There is indeed no fixed rule (excepting only after "death produced by wrongful act," when the amount is usually fixed by statute either at \$5,000 or \$10,000); but, in case the trial judge deems the amount excessive, he has power to reduce the amount or to set the verdict aside. Higher courts, too, may declare the damages "excessive."

Thus much for the courts of the United States, including the juries thereof, as well as also certain important legal principles and definitions. Let us now consider these same matters, though much more briefly, with regard to other lands. And first, as to the

Basic Legal Principles and Chief Courts of England.[2]

In England the fundamental legal principles are much the same as in America. Indeed, as suggested already, these principles were really adopted by the United States in an early day from the mother nation. In England, for instance, the doctrine of *stare decisis* or of case-law, prevails exactly as it does with us, and case-law there is subject to the same identical rules of interpretation as it is in America. The jury system, too, in that country, plays a highly important part, exactly as it does in this country. The English court-system, however, is very different from ours. For one thing, there is lacking, in England, the two-fold idea—federal and state—which makes the law of America so difficult. There is only one system, or series, of courts in England. Then, again, in England there is no written constitution; and, furthermore, questions of constitutionality are decided in that country by the legislative body—Parliament—at the time when a given law is enacted. The courts have nothing whatever to do with such questions. When, in England, a law is once passed, it is law.

The system of English courts, much simplified[3] to be sure, for general presentation, is as follows:

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[1] A would, of course, be liable to a criminal prosecution for mayhem (mutilation) in any jurisdiction, under the circumstances mentioned. We are speaking here only of the civil action which may always be instituted by the defendant, or his representatives (guardian, executor, or administrator) on the same set of facts as the criminal action.

[2] The Welsh and the Irish courts may, to all intents and purposes, be regarded as just like those of England. Not so, however, may the courts of Scotland.

[3] Neither in the case of the English court-system nor in that of any other court-system, is the attempt here made to furnish a scientific exposition of the

Coroners' Courts.—The jurisdiction is a little wider than with us. It extends to deaths and fires (where questions arise as to cause) and treasure trove.

Courts of the Justices of the Peace.—The jurisdiction, as with us, extends only to certain subordinate matters.

County Courts.—Jurisdiction extends to subject-matter whereof the value involved does not exceed £100.

Courts of Session.—Criminal cases only.

Court of Criminal Appeal.—Criminal appeals only.

The High Court of Justice.—Consists of the Chancery Division, the King's Bench Division, and the Probate, Divorce, and Admiralty Division.

Court of Appeal.—Hears all appeals from the High Court of Justice.

The High Court of Justice and the Court of Appeal are, together, called "The Supreme Court of Judicature."

The House of Lords.—Does not consist of all the members of the House of Lords, but of "The Law Lords" only. Hears appeals from the Court of Appeal, and has original jurisdiction in certain classes of cases, not necessary here to be specified.

There is only one Supreme Court of Judicature. England, however, is divided into seven Supreme Court Circuits, and the various judges of the Court apportion the work among themselves according to certain rules, and also in obedience to the ever-changing demands made upon this court by the various circuits.

Cases relating to the unprofessional conduct of physicians fall entirely within the jurisdiction of the General Medical Council—an exclusively medical body which removes the offender's name from the *Register,* (i. e., disqualifies him from practice) in case the offense is proved. The decision of this tribunal is absolutely final.

Suits for medical or surgical malpractice are brought either in the King's Bench or the County Court, according to the amount involved. An appeal lies, first, to the Court of Appeal; then to the House of Lords.

Medical expert testimony may be required in all these courts, excepting only the Court of Appeal, which, possessing appellate jurisdiction only, does not take testimony, either common or expert.

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jurisdiction of the various tribunals named; the endeavor is merely to convey a somewhat general idea of the court-organization of the various nations in question.

Basic Legal Principles and Chief Courts of France.

In France the doctrine of *stare decisis* does not prevail. A judge may, if he choose, decide in one way to-day and in another way to-morrow, on exactly similar states of fact. Neither do ministerial edicts have the force of law in France, contrary to the generally received opinion on that point in this country. They are supposed only to interpret the law, though instances of encroachment have undoubtedly occurred. Constitution, codes and statutes—these are the three constituents of French law.

In France, furthermore, the jury system is conspicuous by its almost absence. In fact, no jury is ever employed in France, except in criminal cases, and then only in the Assize Courts, tribunals which deal, generally speaking, only with the very highest classes of crimes.[1] A jury in civil cases is unheard of. There are, in France, few technical "Rules of Evidence," no perplexing problems with respect to relevancy, materiality, or competency. The mile-long "hypothetical question" never disturbs the intellectual serenity of the medical expert, who merely hands in his report, or discusses, in a gentlemanly fashion, various matters, relevant to the issue of course, with a learned and urbane judge.[2]

The defendant, moreover, in a suit for medical malpractice (which kind of suit, by the way, for reasons to appear hereafter, is extremely rare in France)[3] does not direct a mutilated defense to a body of men who may, or may not, comprehend the nature of the scientific questions involved. On the contrary, he addresses a connected exculpation to a judge (or, it may be, to a benchful of judges) who are ably assisted by official physicians, selected either by the parties or by the court but from a list drawn up at stated intervals by the Court of Appeal in the particular judicial district in which the case is heard. Surely it would not be injudicial to say that they do "order" these things "better in France."

The court-system of France is as follows:

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[1] Even the Assize Court jury could be adopted only during the Revolution, in 1790.

[2] Neither is there in France a Grand Jury. The functions of this exclusively Common Law body are performed in France by a special officer known as the "Juge d'Instruction," a kind of Grand Inquisitor who is entitled to examine "not only the witnesses, but the prisoner himself in absolute privacy." True, there is a "*Chambre des mises en accusation,*" which works in connection with the Court of Assizes, and which is something like our Grand Jury. Nevertheless, its members are not laymen, but judges from the Courts of Appeal. The resemblance, therefore, to our Grand Jury is very superficial.

[3] Everywhere, indeed, in foreign countries, malpractice suits are far less common than among us. So far as I am able to judge, there have been more malpractice cases in the last hundred years in the United States alone than in all continental Europe.

Civil Courts.

a. Courts of Exceptional Jurisdiction (those whose jurisdiction is delimited by statute).

1. *Courts of the Justices of the Peace.*—Jurisdiction up to 600 francs.

2. *Commercial Courts.*—Certain commercial cases only.

b. Courts of Ordinary Jurisdiction.

1. *The Civil Tribunal of First Instance.*—There is one of these for each arrondissement, France, as is well known, being divided into a number of "departements," or states, each of these being subdivided into three or four "arrondissements."

This tribunal is of great importance in connection with the matter of medical expert witnesses, for to it belongs the power, and on it devolves the duty, to construct each year a list of qualified physicians from which the official corps of "medical experts before the courts" may later be chosen. (See Court of Appeal, *infra.*)

2. *The Courts of Appeal.*—There is one of these for each of the twenty-six appellate districts, each appellate district comprising a number of "departements."

These courts are of great importance in connection with the matter of "medical experts before the courts," for this court is the body which possesses the power to appoint, and on which devolves the duty to appoint, from a list proposed, as before stated, by the Civil Tribunal of First Instance, the corps of medical experts.

3. *The Court of Cassation.*—One for all France. Sits in Paris. A court of error only. It never retries the facts, a retrial, if ordered, being referred back to a Court of Appeal other than that which heard the case before.

Criminal Courts.[1]

1. *Tribunal of Simple Police.*—Petit offenses only. Merely the criminal side of the Justice of the Peace's Court.

2. *Correctional Courts.*—All offenses involving a penalty exceeding five days' imprisonment and fifteen francs fine, except such as are reserved for the courts of the third degree, which are the Assize Courts.

3. *The Assize Courts.*—The highest classes of crimes only. The only court in France in which there is a jury.

Medical expert testimony is heard in every court in France.

A suit for malpractice against a physician would be begun in the

[1] Nothing at all like our Coroners' Courts exists in France, Germany, or Italy.

Civil Court of First Instance, and the Court of Appeal of the same district would have appellate jurisdiction.

Basic Legal Principles and Chief Courts of Germany.

In Germany, as in France, the doctrine of *stare decisis* (case-law) does not, theoretically at least, prevail. In actual practice, however, the decision of a court of last resort in the German Empire is given great weight in subsequent similar cases, and is almost always adhered to. Says Schuster: [1] "Theoretically the rule of English law, according to which the judgment of any Court establishing any rule of law is conclusive for all subordinate and co-ordinate Courts, is not accepted in Germany, and any young 'assessor' fresh from his final examination may overrule the judgment of the Imperial Supreme Court, but in practice the ruling that any Superior Court is of the greatest weight and authority. . . ." The authority of legal text-books, too, in German courts, is probably higher than in any other country. Constitution, codes and statutes, however, are, in Germany, as in all other Civil Law countries, of absolutely binding power.

The system of courts in Germany is somewhat peculiar. It is not so simple, quite, as is the system of France (which, in fact, is almost like the simple series of one of our single states) nor, on the other hand, is it quite so complicated as the American state-and-federal plan. It holds, in fact, a position midway between these two systems—the extremely simple system of France and the extremely complex system of America. The highest court in Germany, to be explicit, is a federal court (the *Reichsgericht*) and all the other courts are state courts (courts of the *Bundesstaaten*). The situation is much as if, in America, the Supreme Courts of all the states were abolished, then all the federal courts, except the Supreme Court, were done away with, and, finally, the federal Supreme Court was placed at the head of all the forty-eight state court-systems. Even then, however, we should be embarrassed by forty-eight different kinds of procedure employed in the forty-eight different state court-systems, whereas, in Germany, although the state courts are without exception supplied by the separate states (*Bundesstaaten*) the legal procedure, throughout, is absolutely uniform, being federal.

The courts of Germany are as follows:

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[1] "*The Principles of German Civil Law,*" by Ernest J. Schuster, Oxford, 1907, p. 12.

For Civil Cases.

Amtsgerichte.—Suits involving property rights not exceeding in value the sum of 300 marks ($70.00), and certain other matters requiring expedition, without regard to the amount of the claim.

Landgerichte.—Original jurisdiction in all other civil matters and appellate jurisdiction from the *Amtsgerichte.*

Oberlandesgerichte.—Appellate jurisdiction from the *Amtsgerichte.*

Reichsgericht.—The imperial court: the highest court in the German empire. Sits in Leipzig. Appellate jurisdiction from the *Oberlandesgerichte.*

For Criminal Cases.

Schöffengerichte.—Simply the penal side of the *Amtsgerichte.* One judge and two laymen (or *Schöffen*). Competent for all "*Ubertretungen*" for the so-called "*Antragsvergehen*" and for those "*Vergehen*" punishable at the most with three months in jail or a fine of 600 marks ($140.00).

Landgerichte.—Penal Chamber thereof. For all other "*Vergehen*" and also for "*Verbrechen*" which are punished at most with five years in the house of correction, and for the "*Verbrechen*" of juvenile persons.

Appellate jurisdiction over *Schöffengerichte.*

Schwurgerichte.—Three judges and twelve jurymen (*Geschworene*). "*Verbrechen*" which do not fall within the jurisdiction of the Penal Chamber of the *Landgericht* or of the *Reichsgericht.*

Oberlandesgerichte.—Sit in appeal from judgments of the Penal Chamber of the *Landgericht* which the chamber heard on appeal, and in first instance cases from that chamber where the revision is grounded exclusively upon some legal rule contained in the *Landesgesetzen.*

Reichsgericht.—Penal Chamber thereof. Appeals from *Schwurgerichte* and from the Penal Chamber of the *Landgerichte* in cases in which that chamber had original jurisdiction.

Original and final jurisdiction in treason and high treason against Kaiser and Kingdom.

The court in which either a prosecution or a civil suit for malpractice would be brought, would be the *Landgerichte*—in the case of a prosecution, the penal chamber of the court, of course. The *Landgericht* may, however, refer the case for trial to the *Schöffengericht,* whenever it is perfectly obvious that the case (if a prosecution) cannot result in a judgment for more than six months' imprisonment or a fine of more

than 1,500 marks; and it may even refer a civil suit for malpractice to the *Amtsgericht* whenever the amount of damages demanded does not exceed 600 marks. A matter which seems peculiar to Americans is the extent to which both medical and surgical malpractice are, in Germany, regarded as criminal matters. Thus, it happens again and again, in that country, that the same professional negligence, or alleged negligence, is both sued upon and prosecuted simultaneously. The injured person, however, is not obliged to wait (as in some lands) until the criminal action has been disposed of before he can bring his suit for damages. Nor is he obliged to sue simply and solely because a prosecution has been brought. The prosecuting attorney (*Staatsanwalt*) is, on the contrary, under official obligations to prosecute whenever he learns of a case of probable malpractice—which, not infrequently, is when he first receives intelligence that a civil suit has been begun. It is generally the case, however, that the injured person allows, or causes, the criminal prosecution to precede his civil suit, because, in the criminal action he has no costs to pay, however the case is decided, and also because, if the criminal action is decided in his (i. e., the State's) favor, then he is absolutely certain of a judgment in his case for damages, while if, upon the other hand, the defendant is discharged in the criminal action, such a judgment is no bar at all to a later suit for damages. An appeal from the *Landgericht* would lie to the *Oberlandesgericht* and, thence, to the *Reichsgericht*. The functions of a medical court-expert in Germany are pretty well indicated by the jurisdictions of the different courts. The peculiar hierarchy of medical officials in Germany will be explained later.

Basic Legal Principles and Chief Courts of Italy.

The fundamental legal views of Italy are much the same as those of France. Judicial decisions (*giurisprudenza*) have, as in France, no force at all as law—except as "persuasive authority"—still, contrary to the case of France, ministerial edicts do possess binding authority. The system of courts in the two countries is very similar. Thus, in Italy:

For Civil Cases.

Judici di Conciliatori.—Jurisdiction up to 100 francs.

Pretore.—Jurisdiction up to 1,500 francs.

Tribunale.—Original jurisdiction in all claims of over 1,500 francs, and appellate jurisdiction in certain cases from the pretore.

Appello.—Court of Appeals. Hears appeals from the tribunale.

Cassazione.—Highest court in Italy. Jurisdiction where error has been committed on either side.

For Criminal Cases.

Pretore.—Petty cases.

Tribunale.—The penal chamber thereof.

Corte d'Assise.—Where the crime is punishable by not less than five years imprisonment. Tries by jury, the assize court being, as in France, the only tribunal which acts in conjunction with a jury. No appeal.

A civil suit for malpractice would be begun either in one of the pretorian courts or in one of the tribunale, according to the amount of the demand. A marked peculiarity, however, of the Italian law, is that a judgment for damages cannot be secured against a physician until a criminal prosecution has first been brought against him, and successfully, on the same state of facts.

There is no corps of "official expert witnesses before the courts" in Italy. The medical expert system is, in fact, almost the same in Italy as it is in Common Law countries.

We have now reviewed, in a very brief manner, the court-systems and fundamental legal principles of the various lands proposed to be considered in this section—America, England, France, Germany, and Italy—systems and principles which, to some degree, must be kept in mind, if the remaining (and more specific) portions of this article are to be really comprehended.

II.

OPHTHALMIC EXPERT TESTIMONY.

A.—Legal considerations.

Legal considerations regarding ophthalmic expert testimony in the United States. In America, as in every civilized country, witnesses are, from the nature of the testimony which they give, divided into two very sharply differentiated classes—ordinary witnesses and expert witnesses. The former class simply testify to facts, the latter—the expert—to opinions that are founded upon facts, either actual or assumed. Says Hutchins:[1] "Ordinarily it is the province of the jury to consider the facts in the case, and, uninfluenced by the opinions of witnesses, draw such inferences therefrom as their judgment may dic-

[1] "The Physician as an Expert," *Michigan Law Review,* Apr., 1904, Vol. II, No. 7, p. 601.

tate. But in cases involving questions outside of the ordinary range of inquiry, in which correct conclusions can be drawn from the facts only by means of scientific deductions, it is apparent that most jurors would be unable to perform the functions that the law imposes upon them, unless aided in their deliberations by the judgment and opinions of witnesses skilled and experienced in the subject under investigation.'' From this it readily appears that the expert witness is really an interpreter of the facts. He stands to the jury (or, in some instances and lands, the judge) in much the same relation as a linguistic interpreter does in the case of a witness who cannot speak the language of the court in question, or of a witness who is deaf and dumb. He tells the jury or the judge the real meaning and import of the facts adduced by the ordinary witnesses—a meaning and an import which the judge or the jury could not, presumably, extract from these facts themselves, by reason of their lack of special education with regard to the matter in question.

An expert witness may be a carpenter, a miner, a railroad man or a chemist, a lawyer[1] or a dealer in silks; in very many cases he happens to be a druggist, a dentist, or a doctor; in every case, however, he is called upon to aid the jury or the judge to interpret ordinary facts by means of the expert, unordinary, knowledge which he possesses. Here, of course, we shall treat of these matters with especial reference to the needs of the doctor, and with more especial reference still to those of the ophthalmologist.

First of all, however, it is well enough to understand that certain things are so generally known and accepted that they do not need to be proved by any kind of evidence whatever. Such matters are said, in legal parlance, to be ''judicially noticed.'' Among such matters are: The existence and titles of sovereign powers, their flags and seals, the general customs of merchants, the movements of the astronomical bodies, legal weights and measures, matters of public history, domestic law,[2] etc. All these and various other matters need not be proved. The court is presumed to know them.

Then, too, there is a kind of evidence, which does not depend on human testimony—namely that which arises from what is legally described as ''autoptic proference,'' i. e., the displaying of the thing itself. Says Wigmore:[3] ''If the question is whether a man is of negro complexion, or whether a shoe is fastened by laces or by but-

[1] See the next succeeding footnote.

[2] But not foreign law. Foreign law, as hinted *supra*, must be proved by expert testimony given by those who are specially skilled in the subject.

[3] Note to Greenleaf on *Evidence*, 16th ed., 1899, p. 27.

tons, the testimony of one who has seen the man or the shoe, or the circumstance that the man's child is a negro or that a button has fallen from a shoe, can at least not be more satisfactory than the inspection of the man or the shoe in court.'' Thus a judge may take his watch and note ''the length of a minute for the benefit of the jury,'' and a doctor may demonstrate the effects of an injurious substance, and a man whose eyes have been removed may, under appropriate circumstances, exhibit before the court his empty sockets.

Then, finally, there comes human testimony. This, as a matter of course, plays the star part in almost every trial.

Now, to return to our beginning point, the witnesses who render human testimony are of two great, widely differing varieties—the ordinary and the expert, the latter of which will be considered here.

In treating of expert witnesses we divide our subject thus: *Attendance in court, how secured; competency; examination and cross-examination; privileged communications; matters concerning which an expert witness may testify; manner of testifying; fees.*

The *attendance in court* of any witness is secured by the service of a writ called *subpœna ad testificandum.* The service is accomplished by showing the original and leaving a copy thereof, or else a ticket containing the original in substance. In civil cases there must also be made a payment, or at least a tender, of the amount required for mileage as well as for one day's attendance at the court. In criminal cases, however, the witness pays his own expenses, being afterwards reimbursed by the court in accordance with various provisions of the law.

In court, immediately after the swearing of the witness, there arises the question of his *competency.* In fact, the competency of a witness to testify as an expert must always first be shown before he is permitted to testify in his expert capacity. (Of course, the same man may be testifying both as ordinary and as expert.)

Now then, what is an expert, especially a medical expert? In other words, what qualifications are necessary to constitute a man a medical or surgical expert, or to render him ''competent?'' This is a question of very great importance to the ophthalmic surgeon, as the merest matter of course. In the very first place we may remark that, in order to testify as a medical or surgical expert even in a case of injury to the eye, it is by no means necessary, from a legal point of view, that the witness should be an oculist or even a specialist with any sort or kind of limitation whatever on his practice—as eye and ear only, or only eye, ear, nose and throat. Nor is it necessary that he ever have made a special study of the eye. Nor is it at all essential that he be

a graduate of any particular school of medical practice. Nor, further, that he be a graduate at all, or even a licensee on the ground of years of practice. Nor that he be in the active practise of his profession, or that he ever have practised at any time. None of these matters go at all to the question of the admissibility of the evidence. Such things (i. e., minority of qualification) may, indeed, be shown, on examination either direct or cross, but such matters simply affect the *weight* which the jury may see fit to attach to the testimony that is rendered: they do not *bar* the testimony.

Nevertheless, certain qualifications are really necessary to constitute a man a medical or surgical expert. Now what are these qualifications? They are, in short, *whatever* will tend to confer upon the witness unusual knowledge or skill relating to the matter in question. Thus, in Lind v. Masonic Ass'n of Western N. Y.,[1] a nurse who had witnessed a surgical operation was permitted to testify for what disease the operation had been performed, on the ground that, for twenty-one years he had been a nurse in a hospital and had seen much general and surgical work. Thus, again, in Mason v. Fuller,[2] it was held that a woman who had had no training whatever in medicine, or indeed even in the single branch of midwifery, but who had had long experience as a nurse in child-birth cases, was competent to render expert testimony as to whether the birth of a child was premature. Said the judge: "The witness, by her experience and observation, appears to have acquired knowledge of the subjects about which she was testifying that persons generally do not have." In State v. Cook,[3] it was held that a chemist and toxicologist who was not a physician and surgeon, and who had had no medical training whatever, was competent to testify as an expert concerning the effect of strychnine upon the human stomach and the system in general. In Everett v. The State,[4] it was held that a physician and surgeon who had been in active practice, but who, at the time of the trial, had been retired from professional work for some time, was sufficiently well qualified to testify as an expert. In Tullis v. Kidd,[5] it was held that a witness, to qualify as expert, need never have been engaged in active practice. Said the

1 88 *N. Y. Sup. Ct. R.* 287, 30 *N. Y. Supp.* 775.

2 45 *Vt.* 29.

3 17 *Kan.* 392.

4 62 *Ga.* 65.

5 12 *Ala.* 648, 650. The opinion as to the competency of this particular witness would seem to be *obiter dicta*. Moreover, the case is not a "recent" one, dating, as it does, to 1847. Nevertheless, it is quite within the spirit of legal holdings regarding these matters generally, and would probably be taken as law in almost any jurisdiction in the U. S., where the matter is not controlled by statute.

court: "If one asserts an ability to give correct opinions upon any art or science, from an acquaintance with the subject, acquired by observation and study, we cannot perceive on what ground he can be rejected because he has not been in the actual practice of his profession." In the same case, as it happened, a similar question of competency arose. The witness had attended a course of medical lectures, been licensed by the state, and had practised medicine for one year. Then he had abandoned medicine for the law, and had been engaged in legal practice for sixteen consecutive years. He was held to be competent as a medical expert, partly on the ground that he had never quite ceased to read medicine.

Another extremely interesting instance arose in California.[1] In this case it was held that a Catholic priest might testify as an expert in the matter of mental soundness or unsoundness. The opinion was based to some extent on the ground that the education which this clergyman had received in his school of theology, had been designed in part to fit him to examine into and decide upon such matters. Said the court: "It was a part of his collegiate education, and it was especially a matter of daily practice with him for ten years to familiarize himself with the mental condition of persons upon whom he was called to attend in his character as a priest; and it does seem to us that, from both education and experience, he was peculiarly qualified to express an opinion, as an expert, on the question of mental diseases."

The culminating point of interest, however, regarding this matter of medical expert competency, for the ophthalmologist at least, lies in the fact that the law does not require the witness to have made a specialty, either in practice or in study, of any of the matters concerning which he is called upon to testify.[2] Thus a man who has never seen a case of glaucoma (sometimes, perhaps, who has never read a report of a case—for such men actually exist) is permitted to testify, merely from the sketchiest text-book knowledge of the subject, as to whether or not a given set of symptoms should, or should not, have been diagnosed as glaucoma, and as to whether an iridectomy therefor

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[1] Estate of Toomes, 54 *Cal.* 509.

[2] Hathaway v. National Life Ins. Co., 48 *Vt.* 335, 351; State v. Reddick, 7 *Kan.* 143; Hastings v. Rider, 99 *Mass.* 622; Horton v. Greene, 64 *N. C.* 64; Kelly v. United States, 27 *Fed. Rep.* 616; s. c., 8 *Cr. Law Mag.* 174. In Castner v. Sliker, 33 *N. J. L.* 95, it is held that a physician may testify fully as to various ocular injuries, though neither oculist nor surgeon. Thus, too, Wigmore, citing seven cases, in a note to "Greenleaf on *Evidence*," 16th ed., 1899, p. 54: "On matters in which special medical experience is necessary, the question may arise whether a general practitioner will suffice, or whether a specialist in the particular subject is necessary. The courts usually and properly repudiate the finical demand for the latter class of witnesses." The same writer, *loc. cit.*: "As to sanity, it is now universally conceded that a layman is competent to form an opinion."

should or should not have been performed at all, and whether or not, in case it was performed, it was performed correctly. Perhaps even a nurse in an ophthalmic hospital would be permitted to give evidence on such matters. The absurdity (medically speaking, of course) is sufficiently manifest, but, in the eyes of the law, is entirely removed, or, rather, "remedied," by the fact that the opposing counsel is always permitted to show, on cross-examination, just how slight the expert's real expertness is. However, to one who understands even a very little of human nature (and glaucoma) this privilege of cross-examination constitutes by no means a sufficient defense against misapprehension on the part of the jury. The really inexpert expert's testimony may leave some sort of impression on the jury, whereas, as a matter of course, it ought not to leave any. The testimony of such an "expert" should be inadmissible.[1]

But this is not all. It is held that a specialist in diseases of the eye may not testify regarding medical or surgical matters that do not lie within his special field.[2] Says Rogers, in his admirable work on "*Expert Testimony,*" p. 101: "But one who devotes himself exclusively to one branch of his profession, making a specialty of that, and having no practical experience beyond it, is incompetent, as a general rule, to express an opinion on a question that does not pertain to his specialty." So a specialist that has never been engaged in general practice, cannot testify regarding medical matters generally, whereas a general practitioner, who has never been engaged in special practice, or indeed in practice of any sort or variety, but who has only "studied medicine," may testify regarding matters medical, whether of a general nature or a special. Nay, further, a man who has never even studied medicine, but who has merely served as a nurse, or acted as a minister or priest, may, under certain circumstances, exercise the functions of the medical expert, either general or special.

No doubt the proper rule should be that expert testimony should be really expert; that, for instance, only internists in actual practice at the time of testifying should be permitted to testify regarding matters of internal medicine, practising surgeons regarding surgery, dermatologists regarding dermatological matters, and, similarly, in the case of oculists, aurists, and specialists of every kind. "Pantologists" do not exist, and courts should recognize the fact. Provision,

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1 The following may be instructive: In a certain trial I heard a physician on the witness stand repeatedly refer to a pterygium as a "strinthium." Another "expert," preparing for another trial, spoke often of a "silk-fork" fracture of the radius. These Mrs. Partingtons of the witness-stand might very appropriately be abolished.

2 Fairchild v. Bascomb, 35 *Vt.* 410.

of course, should be made for cases where the "best" evidence could not be obtained, as where, owing to the distance from medical centers, actual experts were not, practically at least, procurable, and where, owing to the death or disappearance of some person, a witness who had actually seen and examined that person would, though not an actual expert, necessarily testify, if any sort or kind of testimony in the matter were to be obtained at all. Some of these matters, of course, could and should be placed within the discretion of the trial court. The prevailing rule, however, should be in accordance with that general principle of evidence, which "requires the best evidence of which the case in its nature is susceptible." [1] A general practitioner cannot give the "best" evidence regarding injuries to, or diseases of, special organs.

It is only fair to add that in the state of Wisconsin a little has been done by statute[2] in the way of barring certain inexpert experts. In this state "no person practising physic or surgery, or both, shall have the right . . . to testify in a professional capacity as a physician or surgeon in any case unless he, before the twentieth day of April, 1897, received a diploma from some incorporated medical society or college, or shall since said date have received a license from the state board of medical examiners." This, as will be seen, bars the nurses, the students, the midwives, and the clergymen, but, unfortunately, does not exclude the inexpert expert who happens to be the proud possessor of a license or a diploma, and yet who cannot distinguish glaucoma from iritis.

Immediately upon the establishment of the "expert's" competency, follows, of course, the *direct examination* and then the *cross-examination*. By "direct examination" is meant the "examination by the counsel for the party in whose behalf he was called." Under this examination the witness may either (a) tell his story in narrative form, or (b) respond to various (and generally numerous) questions. When giving his testimony according to the latter method, the questions must not be "leading"—i. e., such as suggest the answer desired. The ordinary witness, too, must confine himself strictly to facts, excluding rigidly all opinions or inferences; the expert, however, may, within certain limitations of course, give testimony as to opinions; in truth he is really an "opinion" witness.

The cross-examination is made by the opposing counsel, and its purpose, of course, is to overthrow or weaken the testimony rendered under the direct examination. In the cross-examination, leading ques-

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1 Greenleaf on *Evidence*, 16th ed., 1899, p. 170.
2 *Wisconsin Statutes*, 1898, Vol. I, Sec. 1436.

tions are permitted. The "latitude" (i. e., scope, or field, covered by the questions) allowed in the cross-examination is different in the different states. On the whole, the best rule would seem to be that a witness is subject to cross-examination on everything that is relative to the *case.* The rule most generally adopted, however, is that the cross-examination must be limited strictly to matters concerning which the witness testified under his direct examination. The whole matter of latitude, however, lies largely within the discretion of the trial judge.

All the evidence, it may be noted, in passing, must be relevant and competent. By relevant is meant "of sufficient probative value to be admissible at all."[1] By competent is intended, legally fit, regardless of the question of relevancy. One of the subordinate rules coming under the rule requiring "competency," is the so-called "best evidence" rule, by which is meant, as before stated, that a court will require to be produced "the best evidence of which the case in its nature is susceptible." Another subordinate rule, under the general rule of competency (perhaps, too, falling under that of the "best evidence") is that "hearsay evidence is not admissible." Thus, a physician, for example, may not testify that another physician had said to him that such and such an injury might very readily have caused the plaintiff's traumatic cataract. He must give his own opinion. If the opinion of the other physician be desired, then that other physician must be brought into court, there to render such opinion.

Closely connected with the subject of direct and cross-examination, is that of *privileged communications.* Even in the earliest times in England (from which country we inherit, as before stated, most of our fundamental legal principles) certain matters have been considered inviolably sacred, and have been most carefully protected from disclosure in the courts. Such matters were called "privileged communications," and were privileged at the common law—i. e., they did not require a statute for the purpose of rendering them privileged. It was "case law," or "judge law," or "common," or "unwritten" law. These privileged matters were, in general: State secrets, deliberations in the jury room, communications between counsel and client, and communications of a confidential nature between husband and wife. Communications, however, made to clergymen and doctors, though sacred in fact, were not held to be sacred, or "privileged," in law. Hence these matters are unprivileged still, even in the United States, except so far as has been provided otherwise by statute. Happily, in most of the states of this country, statutes have been enacted which,

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[1] Greenleaf on *Evidence,* 16th ed., 1899, p. 36.

with certain appropriate limitations, protect the physician from disclosing on the witness stand, without the patient's consent, "any communication made to him by his patient with reference to any physical or supposed physical disease, or any knowledge obtained by a personal examination of any such patient."[1]

As to the *matters concerning which an expert witness may testify,* we may say that these, in a word, considered together, are about as wide as the whole broad field of medicine. Most commonly in question, however, in courts of law, are the following medical topics: Whether a given person is insane; the cause of a certain death; whether a certain disease is incurable; whether a certain disease is curable without operation; what might have been the cause of a given injury; what a reasonable bill would be for certain medical or surgical services; whether a certain affection is or is not painful; the degree of reduction in earning power produced by a given disease; the probability of this reduction (or of some disfigurement) being permanent or temporary.

As to the expert's *manner of testifying,* it is hardly necessary here to enter upon the customary platitudes, such as that the expert should always be honest; that he should neither speak too loud nor yet in a whisper; that he should always act the gentleman; never put in technical terms what could be more simply stated; etc., etc. However, one admonition may not be out of place: viz., an expert, and more especially an *expert* expert, as an ophthalmic surgeon is always supposed to be, should ever be exceedingly careful not to express an opinion with too great particularity. This, I think, is a fault to which the specialist is notably prone. He seems, in fact, to feel that he is expected to be very precise and accurate, just because he is a specialist. Nevertheless, he should not testify, for example: "My opinion is that this traumatic cataract was caused by a blow from a heavy cane," for, in fact, no one could tell, merely from the injury, whether a given cataract had been produced by a heavy cane or a light one. To refer to an actual instance: He should not allege that a certain detachment of the retina had been produced by a snowball, squeezed very hard. The same detachment might, in truth, have been produced by almost any solid object impinging upon the eye with violence.[2]

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[1] The language of the statute varies, to be sure, in the different states. The matter above quoted is from the Kansas statute.

[2] I saw, however, an interesting case of ocular injury (never the subject of legal investigation) in which an expert witness could easily and truthfully have testified with exceedingly great precision. The wound had been inflicted by a butcher with his "steel," or knife-sharpener, on a customer with whom he had had an altercation in his shop. The partly punctured, partly contused, character of the wound in the cornea, together with the presence of raw beef fibres in the

An expert witness, as before stated, may testify either to facts or to opinions; i. e.—either in his ordinary or in his expert capacity. When testifying to opinions, his opinions may be based either on facts observed and testified to by himself, or on facts observed and testified to by others. In the latter contingency (and in that alone) the questions which are asked him must ever be fashioned in what is technically known as the hypothetical form. It therefore behooves the medical expert to understand somewhat the nature of *the hypothetical question.*

Now, what is "the hypothetical question?" The hypothetical question is a question which is based upon the assumption that all, or part, of certain facts already in evidence, or yet to be placed in evidence, is true. It *assumes,* or *hypothecates,* the truth of certain fact-testimony, in order that the opinion-witness, i. e., the expert, may have an opportunity to render an opinion thereon. The very reason for the existence of such a form of question, is that it is not the function of the expert, but of the jury, to determine whether or not such fact-testimony is true. The jury may accept the fact-testimony together with the opinion which is based upon it, or the fact-testimony without the opinion, but, under no circumstances, of course, can it reject the fact-testimony and accept the opinion.

Perhaps an illustration will serve to clarify the nature of this important kind of question. Doctor A, an oculist, is called to the witness-stand. Having been sworn and qualified, he is asked, for instance, "What did the defendant then do?" *Ans.*—"He struck the plaintiff with a stick." *Q.*—"On what part of the body did the blow fall?" *Ans.*—"I do not know; I was not close enough to tell exactly." All this, it will be observed, is merely "ordinary," or fact, testimony—such as any witness might conceivably be able to furnish. Suppose, now, another physician, Doctor B, has testified that the plaintiff's uninjured eye is only rudimentary and has never at any time had sight, and, further, that very shortly after the assault he, Dr. B, dressed the left eye (the eye which defendant is said to have injured, and for damages to which the present suit is brought) and that, in the injured eye, he found a sliver of wood 2½ inches long, ½ inch wide, and ⅛ inch thick, impaling the eye "fore and aft," passing from the center of the cornea to the back of the eye, there perforating the wall of the eye and piercing the orbital fat, or cushion on which the eye is supported. In this condition (still other evidence has shown) the plaintiff walked along six blocks, making three turns, picking his way

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anterior chamber and in the conjunctival cul de sac, bespoke the nature of the instrument with which the wound had been inflicted, to a high degree of certainty.

over crowded crossings, and avoiding by himself numerous vehicles and foot passengers, that then, still unassisted, he ascended the stairs to Dr. B's office and rang his bell. Now, counsel for defendant desires to show by Dr. A that such acts could not have been performed by anyone with his eyes in the condition above-mentioned. His question will have to be hypothetical, because it is based on facts (and opinions admitted on both sides—which are treated as facts) that had been testified to by others. *Q.*—"Could a man with one eye blind from birth and with the other impaled 'fore and aft' by a sliver of wood 2½ inches long, ½ inch wide, and ⅛ inch thick, passing from the center of the cornea to the back of the eye, there perforating the wall of the eye and piercing the orbital fat, or cushion on which the eye rests—could a person in such a condition have walked, alone and unassisted, six blocks, making three turns, picking his way over crowded crossings, etc., etc.?" *Ans.*—"In my opinion, he could not."

But suppose that Dr. A has been asked to examine the plaintiff, and to report upon the findings. He discovers, let us say, in the plaintiff's left eye a small circular scar on the cornea, 2 mm. in circumference, well off the pupillary area, and, in addition, a sound lens, a sound vitreous, a sound fundus—in short a totally sound eye in every single particular, saving and excepting the corneal opacity only, that being so situated as not to interfere with the sight. The doctor may now be examined *actually*, instead of *hypothetically;* for the reason, as above-stated, that he now is "personally acquainted with the material facts in the case."[1] He may be asked, for instance: "What did you find?" *Ans.*—"I found on the left side an eye perfectly sound in every way, excepting a slight scar on the cornea." "Where was this scar situated with reference to the pupil?" "To one side of it." "Does it interfere with the sight?" "No." "Is there anything to show that the eye may not have perfect vision?" "There is not."

It is well enough to note, before we leave the subject of the hypothetical question, that the term "hypothetical" has reference to the sense and not to the mere verbal form. What is really necessary is that the question hypothecate, i. e., assume for the time being, instead of deciding, the truth of more or less of the fact-testimony. A question may, indeed, be cast in hypothetical form (see, for instance, Fairchild v. Bascomb, 35 *Vt.* 415) and yet, after all, be of such a nature as to require the expert, should he respond, to decide upon the truth of the evidence. On the other hand, a question not at all hypothetical, linguistically considered, may yet avoid the error referred to.[2]

[1] Rogers on *Expert Testimony,* 1891, p. 75, footnote 2.

[2] Gilwan v. Town of Strafford, 50 *Vt.* 726.

The test is: Does the question require the expert to decide upon the truth of any fact-testimony (besides that given by himself, of course) and thus to take that function from the jury?

A subordinate, yet not wholly unimportant, matter is that of the expert's *fees.* We have already seen that, in criminal cases, no fee of any sort need ever be paid or tendered to render valid the service of the subpœna, while, in civil cases, the mileage and *per diem* must always be paid, or tendered, to the prospective witness (whether expert or ordinary) to render the servic of the subpœna effective. No payment or tender, no service. Now, in the case of the ordinary witness, that is all the pay there is, even in civil cases. At least it is all that there ever should be. In the case of the ordinary witness, any further compensation is likely to get him into trouble, on the ground of bribery, or even perjury. When, however, the witness is summoned to give, not ordinary fact-testimony, but scientific opinions involving the possession of learning and skill, then a much-mooted question very naturally arises. Ought, or ought not, an opinion witness, an expert, to be obliged by the law to hold his store of knowledge free for the use of all who take it into their heads to litigate? To illustrate: Here is a civil suit against a railway company, brought in the Alexander County, Illinois, circuit court—a case which requires for its proper decision a certain amount of expert medical knowledge and skill. An oculist, we will say, is subpœnaed from Chicago. He is obliged, possibly, to come in person to Cairo, to lose perhaps several days of his practice, and to undergo in addition various sorts of inconveniences. He has, moreover, to "turn himself wrong side out" for the benefit of people whom he has never seen, who care nothing for him or his interests, and who are striving, the one side to get money, the other side to keep it; and the question is, Shall he do all this for nothing, or, at all events, what is practically nothing—i. e., his mileage and a nominal *per diem*—not quite enough, perhaps, to pay his actual expenses, to ignore the matter of his loss of practice in Chicago? The ablest writers answer the question thus: No, he ought not; the expert's learning and skill are his property, and the law has no more right to compel him to render expert testimony against his will, or at least without adequate compensation, than it has to compel him to render professional services of any other sort. However, the writers and the courts are very much at variance, and, unfortunately for the expert, the courts are not at variance with each other on this question. They hold, with very unusual unanimity, that the expert, medical or lay, may be compelled to testify in his expert capacity without other compensation than that of an ordinary witness. The court of last

resort (Supreme Court) in Indiana has indeed held to the contrary, but, even in that state, the decision has been annulled by a statute, while, on the side of the general rule, are ranged the highest courts of Alabama, Illinois, Arkansas, Colorado, Texas, Minnesota, and even of still other states. It has been suggested that the rule, in its actual application, works no injustice, since, in no case whatever, would counsel be willing to take his chances with a medical witness angered by the non-payment, or the prospect of non-payment of extra compensation. This suggestion, however, amounts simply to an insinuation that medical experts will, as a rule, in case they receive no extra compensation, be willing to perjure themselves—an insinuation which physicians, naturally, resent most bitterly. Moreover, in many cases, the party summoning the expert is a pauper, who, of course, cannot pay the "extra compensation" in advance, and who, after receiving a judgment for say ten or twenty thousand dollars, divides the amount with his lawyer, and then, knowing that the law allows no extra compensation to the doctor, says to the medical expert, "For you, nothing." This may happen, too, after the doctor has made most arduous preparation for the case—perhaps quite as arduous as that which has been made by the lawyer himself.

However, the situation as a whole is not so bad as the judge-made law would seem to make it. In several states statutes provide for the payment of special fees to experts. Among these are: Iowa, Louisiana, North Carolina, Rhode Island, and Wyoming.

In any case, where an expert accepts, or is promised, extra compensation, the retaining or receiving of this extra payment should never be made contingent upon the success of the side in whose behalf the physician is called upon to testify. Everything should be strictly ethical and fair, for the reason, if not for any better one, that the entire matter of the expert's compensation may be brought out fully before the court in his cross-examination.

Legal considerations regarding ophthalmic expert testimony in England. In England the law relating to expert witnesses is much the same as in America. In fact, in neither of these lands is there anything at all resembling an official corps of medical experts, such as, later, we shall find exists in Germany and France.[1] Furthermore, as we saw some distance *supra,* the common law (decisions of courts of last resort) in America has a certain degree of persuasive authority in the courts of England, just as the reverse holds true.[2] It is, then (partly, no doubt, in consequence of this persuasive authority) a fact

[1] But not Italy.

[2] American cases are frequently cited in English text-books and vice versa.

that the English law relating to expert testimony is almost identical with the law on the same subject prevailing in America. The method of securing attendance in court, the rulings with regard to competency, the procedure relating to examinations and cross-examinations, etc., etc.—these and various other affairs relating to expert—as well as ordinary—witnesses, are managed in England almost the same as in America. Especially worthy of notice is the retention in the mother country of the old-time rule already adverted to in this article of excluding the testimony of physicians from the list of matters regarded by the courts as "privileged." Thus *The Encyclopedia of the Laws of England:* [1] "The statute law of many foreign countries enforces this obligation [of medical secrecy] by penalties, and regards it as sacred even in the witness-box. English law, however, takes a different view, and, if the judge sees fit, compels a medical witness to reveal in open court the most confidential communications, and to disregard the most solemn promises." In England, therefore, the law on this point is exactly the same as it is in the different states of the United States (for example, Illinois) where the matter has not been changed by statute.

Legal considerations regarding ophthalmic expert testimony in France. The medical expert system of France, though not entirely transferrable to a Common Law country like ours, is nevertheless so excellent and in so many particulars, and, moreover, spite of the recent date of its adoption, has worked so admirably, that we take great pleasure in presenting it here with just a suggestion of detail.[2]

We shall deal with the subject under the heads of: (1) Appointment of medical experts. (2) Procedure of medical investigations in civil matters. (3) Procedure of medical investigations in criminal matters. (4) Medical expert reports.

Appointment of medical experts.—At the commencement of each judicial year, and in the three months following the opening of the court, the Court of Appeals, sitting in council, together with the aid and consent of the procureur general, appoints from a list prepared (as stated heretofore) by the civil tribunals of first instance a number of physicians on whom the appeals court confers the title of "expert before the courts." In the Court of Appeals of Paris, the appoint-

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[1] 1900-1909, Vol. 9, p. 126.

[2] I am informed by an eminent French authority that perhaps the only objection which could properly be raised to the French expert system is that "experts are not always appointed with a great deal of care." Thus, for example, general practitioners are not infrequently assigned to duties that properly belong to the field of specialism, and *vice versa.* Again: "It has happened that the court in certain instances has appointed a specialist in one matter as expert in regard to another specialty."

ments in question are made by the first three chambers of that tribunal.

The conditions of eligibility to appointment by any Court of Appeals are: 1.—That the physician be of French nationality.[1] 2.—That he have his legal domicile either in the arrondissement of the tribunal, or, at all events, within the territorial jurisdiction of the Court of Appeal by which he is appointed. 3.—That he shall (a) have had at least five years of the actual practice of his profession, or (b) be furnished with a diploma from the University of Paris bearing the mention, "Legal Medicine and Psychiatry," or one of the analogous diplomas conferred by the other French universities.

Expert investigations and examinations may, in general, be conducted only by physicians who bear this title of "Expert before the Courts," and, as a natural consequence, such experts appear in every class of cases and in every court, even the Court of Cassation. According to the *Code of Criminal Procedure*,[2] however, other physicians may be appointed in cases of "flagrant crime, inquiries ordered by a Court of Appeal, or measures taken by the president of a Court of Assizes by virtue of his discretionary power." Other cases in which non-intitulated experts may be appointed are: When the experts properly intitulated by the Court of Appeals are for good reason disqualified to act in a particular case (as by consanguinity, affinity, personal interest in the suit, etc.) when there is great urgency, and also in other cases by reason of special circumstances. In every case, however, of such anomalous appointment, the order of appointment must be supported by a written statement of the reasons for which the anomalous appointment is made. Further, even in the case of anomalous appointments, the appointee must be a French physician.

The experts are appointed either by the court or by the parties, sometimes by the parties and the court acting conjointly.

The foregoing rules relating to the qualifications and the appointment of medical experts, apply indifferently in civil and in criminal matters. The procedure, however, according to which expert investigations are conducted, differ somewhat in the two classes of cases.

Procedure of medical investigations in civil matters.[3]—1.—The expert, or experts, whether appointed by the courts or chosen by the

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[1] The law on this point is very explicit and positive: "Les fonctions de médécins experts près les tribunaux ne peuvent être remplie que par des docteurs en médecine français."—L'article 14, Sec. 1 er de la loi du 30 Novembre 1892.

The German law is by no means so particular.

[2] *Code d'instruction criminelle,* articles 43, 44, 235, et 268.

[3] These rules, somewhat abridged and otherwise modified, are taken from Simon-Auteroche, "*Manuel Pratique de Droit Médical,*" Paris, 1908, pp. 108-112,

parties, are not obliged to accept either the appointment or the choice,[1] but, the mission once accepted, its duties are obligatory and must be completely performed. If they are not fulfilled completely, the expert is obliged to defray all frustratory expenses, and also to pay (sometimes very heavy) damages.

2.—Expert witnesses, like common witnesses, may be challenged on grounds of relationship, affinity, etc.

3.—Experts must take a certain oath, not necessary here to be specified.

4.—Expert investigations must be conducted (when it is proper so to do) in the presence of the interested parties or those who lawfully represent them. For reasons of expediency, however, the presence of the parties may be dispensed with. But even then, the parties should have a chance to be represented by a physician, or physicians, of their choice.

5.—If several experts be chosen or appointed, they should construct but one single report. In case there should arise a diversity of opinions among the several experts, all the different opinions may be stated in detail, but no particular opinion may be attributed to any particular expert. All the different opinions must proceed from the board of experts as a whole.

Procedure of medical investigation in criminal matters.—1.—Medical experts, in criminal matters, are not invariably at liberty to reject an appointment by the court. They may do so only in certain cases.

2.—An expert may be successfully challenged, in criminal matters, much more readily than in civil affairs. "There must not be the least suspicion of prejudice or partiality, even involuntary."

3.—It is not at all necessary that the operations of the experts be conducted in the presence of the parties or of those who legally represent them.

4.—The report of the experts may, if expedient, be verbal. (It may not, under any circumstances, be verbal in a civil suit.)

5.—Medical experts must invariably be placed under oath both before commencing their investigations and, once more, before they testify in court.

Reports.—Expert reports, according to Simon-Auteroche,[2] are composed of four essential parts:

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[1] In Germany precisely the contrary condition prevails. In that country not merely an official physician, but every physician, so long as he remains in public practice, is obliged, on the suggestion of the proper authority, to act as expert either in civil or in criminal matters—unless indeed he can furnish an acceptable excuse.

[2] *Loc. cit.*, p. 112.

1.—Preamble (reciting the names of the experts, the order of the court by virtue of which the investigation was made, etc.).

2.—Statement of the facts.

3.—Discussion.

4.—Conclusions.[1]

Legal considerations regarding ophthalmic expert testimony in Germany. In Germany, too, as well as in France, there exists a corps of official expert witnesses. In Germany, however, the system is, in a manner of speaking, a "blend" of the French and the Common Law systems; that is to say, although there exists in Germany a corps of official experts, yet these do not so uniformly appear before the courts—i. e., to the almost total exclusion of non-official experts—as is the case in France. In Germany the parties have a right to propose and even to demand the summoning of non-official experts of their own naming, and, indeed, in civil cases, they may bring their own physicians with them, without so much as having made the slightest preliminary suggestion to the court.

The power to regulate medical affairs resides, in Germany, in the first instance, with the imperial authority, but these matters have, for the most part, been delegated to the separate Bundesstaaten, so that, in the different Confederated States, there obtain somewhat different systems of medical experts. However, to take the organization of the Prussian experts for an example: The head of the corps is the "Minister der geistlichen Unterrichts- und Medizinal-Angelegenheiten." Under this official functionates an "Abteilung für die Medizinalangelegenheiten," a branch of which is the "Wissenschaftliche Deputation für das Medizinalwesen," the highest consulting class. Each province has its "Provincial-Medizinal-Kollegium," each county its "Kreisärzte."

The members of this official medical corps take on the duties of expert witnesses only when called upon by the police or the State's Attorney (*Staatsanwalt*).

In addition to the system above mentioned, there are in some of the larger cities of Prussia the so-called *Gerichtsärzte*, or (law) Court Physicians.

All the official physicians in all the confederated states are appointed by the Minister for Medical Affairs (*Medizinal Angelegenheiten*) in no case being elected, or even proposed, by the public. The tenure is

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[1] We do not enter here into the question of privilege or non-privilege with respect to medical testimony in France. The subject is extensive, and may be found fully treated (if not absolutely up to date) in Brouardel's "*Le secret médical,*" Paris, 1893.

for life, and all receive a yearly salary (*Jahresgehalt*). Some of the officials are allowed to engage in private practice.

An appeal lies from the report of a *Kreisarzt* or a *Gerichtsarzt* to the *Provinzial-Medizinalkollegium,* and, still further, to the "*Wissenschaftliche Deputation,*" this last-mentioned body being the highest consulting class, or, as it were, supreme court, for medical expert matters in Prussia. This, however, does not mean that the *Kreisärzte* (county physicians) and the *Gerichtsärzte* (city court-physicians) are limited to the giving of testimony in the inferior courts, such as the *Amtsgerichte,* the *Schöffengerichte,* and the *Landgerichte.* They, in fact, may testify as official expert physicians in the *Oberlandesgerichte* (which they do quite often) and even in the *Reichsgericht* itself (though, of course, not so frequently). The *Provinzial-Medicinalkollegium* may be appealed to in a *Schwurgericht* (in important criminal matters only) in an *Oberlandesgericht,* and in the *Reichsgericht;* but never except when first the *Kreisärzte* (or *Gerichtsärzte*) have already been heard in the same court. Similarly, when the *Provinzial-Medizinalkollegium* has been listened to (in any of the same three higher courts) an appeal may be taken on the medical questions involved to the *Wissenschaftliche Deputation.* The parties themselves may propose these medical appeals, but have no right to demand them. The right of decision belongs to the court itself.

Numerous forms are furnished and directions given for the construction of medical expert reports. Non-official experts are bound to follow the forms in certain matters only, while the official experts are obliged to make use of them in practically every sort and kind of case.[1]

The experts of first instance for any individual case, (other than the *Kreisärzte* and *Gerichtsärzte,* who, of course, act by virtue of their office) are generally appointed by the court. The appointees, however, can, for cause, be challenged by the accused, the complaining witness, the prosecuting attorney, and, in civil cases, by the plaintiff or the defendant. So, sometimes, may even the official physicians be challenged. In criminal cases the parties may propose, and even demand, the calling of non-official experts by the courts, while, in civil suits, the

[1] Rapmund and Dietrich recommend to non-official experts the following of official forms in every case. "*Arztliche Rechts- u. Gesetzkunde,*" Leipzig, 1899, p. 462.

By the way, those who desire to behold a combination of Teutonic scientific and legislative thoroughness in one single documentary masterpiece, are referred to the Prussian "*Regulativ vom* 14 *Februar,* 1875" (concerning the manner of performing obductions and constructing reports upon the findings) contained in the work of Rapmund-Dietrich just mentioned, p. 475 ff.

parties may, as already stated, bring their own experts with them, just as is done in this country.

Contrary to the rule in France, it is quite permissible to allow a foreign physician to testify as expert, even though he had never qualified as physician under German law. The matter lies wholly within the discretion of the trial court.

A report by a physician, or by physicians, of the first instance, is called *ein Gutachten.* One, however, that is made by either of the medical appeal bodies, is called *ein Obergutachten.*

In connection with the subject of expert testimony, it is worth while to note that, in Germany, professional secrecy is very rigidly enforced. Thus the Penal Code (*Strafgesetzbuch*), sec. 300: ". . . Physicians, surgeons, midwives, pharmacists, and any assistants of any such persons, shall, in case without authority they reveal private matters, which have been entrusted to them in consequence of their callings, be punished by a fine not to exceed 1,500 marks or by a jail imprisonment not to exceed three months."

However, in a court of law, professional secrets are, of course, legally divulgeable up to a certain extent. To exactly what extent, the law is very specific in many respects, though not all, laying down various regulations regarding non-official and official experts and also others as to official experts after these have ceased to occpy their official positions.[1]

In general, a witness is neither punishable criminally nor responsible in a civil suit for damages on account of any testimony which he may have given (veraciously, of course) on the request or demand of a court of proper jurisdiction.

Legal considerations regarding ophthalmic expert testimony in Italy. In Italy there is no corps of "experts before the courts." Any physician practising in Italy may be cited to appear and serve as an expert.[2]

It is, however, absolutely necessary that a man, in order to be competent as an expert, should be a licensed physician. He is not, nevertheless, required to be in active practice at the time of acting in his expert capacity.

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[1] Thus, for instance, the *Code of Civil Procedure (Civil-prozessordnung)* Sec. 376: "*Oeffentliche Beamte, auch wenn sie nicht mehr im Dienste sind, dürfen über Umstände, auf welche sich ihre Pflicht zur Amtsverschwiegenheit bezieht, als zeugen nur mit Genehmigung ihrer vorgesetzten Dienstbehörde oder der ihnen zuletzt vorgesetzt gewesenen Dienstbehörde vernommen werden.*" The *Code of Criminal Procedure (Strafprozessordnung)* Sec. 53, holds precisely the same language.

[2] There is, to be sure, a corps of sanitary physicians grouped in a kind of hierarchy, as in Germany; but this is an altogether different affair from a corps "of experts before the courts." This sanitary corps will be treated under the heading of *Ophthalmo-Sanitary Legislation in Italy.*

In damage suits, based on injury to special organs, the expert witness need not be a specialist in diseases of the organs concerned; nor is there any law forbidding a specialist who practises only a specialty, to render expert testimony outside his particular field.

A related matter is that an expert witness of one school of practice is allowed to testify in a suit for malpractice against a physician of another school.[1]

In criminal cases the number of experts is, as a rule, two; in civil cases, however, either three or one. In criminal cases the experts are appointed by the court (though the appointees may for just cause be challenged); in civil cases the parties agree upon their experts, or, in case of their inability to agree, the experts are selected by the courts.

All experts selected by the courts are paid from the public treasury. Those selected by the parties are compensated by the parties, except where one or more of the parties are indigent—then the public treasury is once more called into requisition.

We may add, finally, that, in criminal cases, the court has power not only to compel the experts to attend and deliver testimony, but also to prepare themselves therefor by laborious investigations.[2]

B.—Surgical Considerations Regarding Ophthalmic Expert Testimony.

The surgical side of the subject of expert testimony relates (so far as concerns the purposes of this article) to the following matters: The commonest injuries with which the ophthalmo-surgical expert witness has to deal; simulation and the tests therefor; the false attribution of injuries and diseases and the tests for that subtle form of falsification; exaggeration and the tests for that; dissimulation and cautions; visual economics; questions of a general nature relating to the power of vision and the condition of the eye after death and during sleep; the ocular signs of poisoning, burning, etc.; and, finally, the ocular indications of identity.

The commonest injuries with which the ophthalmic expert has to deal.[3] Injuries of the sort in question are: Wounds and burns of the ocular adnexa (the eyebrows, the eyelids, and the extra-bulbar

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[1] As before mentioned, only in the United States is it forbidden that an expert of one school shall testify in a suit for malpractice against a physician of any other school. Surely in this particular the law of the United States is very much in advance of that of any other nation.

[2] In the United States a physician can be required to attend a trial and to give impromptu answers both in civil and in criminal cases. He cannot, however, in either class of cases, be required, against his will, to make any sort or kind of preparation for the giving of his testimony.

[3] For a very complete discussion of ocular injuries in their strictly scientific (as well as to some extent in their medico-legal) aspects, the reader is referred to Harry V. Würdemann's "*Injuries of the Eye,*" also to the indispensable works of A. Maitland Ramsay; further, to the appropriate headings in this *Encyclopedia.*

contents of the orbit); wounds and burns of the ocular conjunctiva, the cornea, and the sclera; and, lastly, wounds of the deeper portions of the eye.

Wounds of the eyebrow are generally very simple and altogether harmless, directly and indirectly. There is swelling, perhaps, and ecchymosis, and a little throbbing pain. Resolution, as a rule, is prompt. Sometimes, however, instead of resolution, there follow periostitis, suppuration, and necrosis. Also, the outer wall of the frontal sinus may be crushed in, with resulting chronic empyema of that cavity. The supra-orbital nerve may be injured in such manner that the traumatism is followed, after a time, by persistent neuralgia. This is generally when the nerve is incarcerated in an adherent cicatrix.

It is now and then important to differentiate between contused wounds of the eyebrow and incised wounds of the same part. Such a distinction would, at first thought, seem sufficiently easy in almost every instance; yet, as a matter of practice, this is not at all the case, for contused wounds of soft parts which are underlaid by prominent bony ridges have a way of looking almost precisely as if they had been occasioned by an instrument possessed of a cutting edge. Thus, I have seen a case where a man had had his eyebrow split by a blow of a fist almost as cleanly as if the injury had been produced by a knife; yet I myself had seen the blow delivered, and was certain that nothing but the naked fist had been employed.[1]

The distinction between the apparently incised, but really contused, wound of an eyebrow, and an incised wound of the same part, is made by four indications: *First,* the wound which is really contused is more likely to possess an areola of ecchymosis. *Second,* under a lens, the walls of a contused wound are seen to be not actually smooth, but more or less ragged. *Third,* while an incised wound shows all the tissues divided just as deeply down as the wound reaches, a contused wound simulating an incised wound, shows some of the more resisting tissues, or fibres, undivided, while others, deeper down in the wound, are severed. *Fourth,* the really contused, though apparently incised, wound is generally more extensive (longer) at the bottom than at the surface, while the really incised wound is apt to possess a so-called "tail" both at the beginning and the end—in other words, to be of greater extent in the skin than in the deeper tissues. This distinction is due to the fact that, in the really incised wound, the

[1] I have also seen an elbow split by a pair of brass knucks so cleanly that, without the carefullest examination, one would almost be willing to swear that the wound had been made by the sharpest of knives.

inflicting instrument cuts from without inward, whereas, in the case of a wound of the contused variety, the incising instrument—the bone—cuts from within outward.

This distinction is often important, as, on the expert's ability to make it, not infrequently, at the preliminary trial, hinges the question whether a defendant is to be held for assault with intent to kill, or only charged with simple assault and battery. Later, the distinction and the expert's ability to make it, may mean to the accused the difference between the penitentiary and freedom.

The distinction above mentioned is similar to that (which is also very important) obtaining between an incised wound about the body almost anywhere and a wound produced artificially (artefact) by the lifting and carrying of a body which has been severely burned, or cooked. A burned body is found, perhaps in the ashes of what was once a house. Certain solutions of continuity appear in divers places about this body, suggesting the inquiry whether a murder has not been committed and then the house set fire to, in order, by incinerating the body, to cover the traces of the crime. On the other hand, the question arises whether the fissures, or apparent incisions, may not have been produced in the easily parted tissues by the lifting and carrying of the body from the site of the burning. Now, when a deep fissure is produced in burned tissues by the lifting and carrying of the body, there will often be fibers, high up in the fissure, which have not parted. Thus is easily and certainly established the fact that no incised wound had been inflicted before the body was burned; for, in case of a wound by a cutting instrument, all the tissues would be divided down to the very bottom of the incision.

Sometimes an injury to the eyebrow is complicated by suppuration of the orbital connective tissue (orbital abscess) and even though this abscess be properly evacuated, and the prospect of recovery is, for a time, apparently good, total loss of sight may nevertheless follow later, by reason of the cicatricial tissue formed in the suppurating cavity slowly contracting around the retro-bulbar portion of the optic nerve.

Fracture, direct or indirect, of the optic foramen is a not very infrequent accompaniment of severe contusions in the superciliary region; and, in such cases, a retro-bulbar neuritis (often of very slow onset) may develop, with the production of blindness more or less complete and absolutely hopeless. Secondary retro-bulbar neuritis may also occur in consequence of various effusions or of the pressure from callosities which, in their turn, have been produced by periostitis.

Fracture of the base of the skull, with meningitis and death can also occur as a complication of contusions of the eyebrow.

From all the above-mentioned considerations it appears that the ophthalmo-surgical expert should be extremely cautious when setting forth the ultimate prognosis of injuries to the eyebrow.

Burns of the eyebrow are generally not important. If other ocular structures are involved, the fact is sufficiently patent. It is often the case, however, that cicatricial contraction follows in the wake of superciliary burns, with consequent great disfigurement.

Wounds of the eyelids, without the involvement of deeper structures, are generally unimportant,[1] and, owing to the carefully protected situation of the eyes, are not common. The danger is that deeper structures may be involved. Infection, also, may turn an apparently trivial trauma of the eyelid into a matter of life and death, in consequence of the resulting erysipelas, lock-jaw, etc. Further, a wound which, on any other account, would be sufficiently trivial, may prove serious indeed if the lacrimal canaliculus be involved, because, by obstruction of this passage through the formation of cicatricial tissue, epiphora (or running of the tears down onto the cheek, instead of through the lacrimal passages into the nose) is produced, and much consequent interference with vision, on account of the continual presence of tears on the front of the eyeball. Sometimes, too, a traumatism of the eyelid gives rise, through closure of the ducts of some of the Meibomian glands, to Meibomian cysts; but these are comparatively harmless and are very easily remedied.

Burns of the eyelids are much more serious than uninfected eyelid wounds, because, after burns, cicatricial contraction may so distort the lids that they no longer fulfill the important offices for which they were provided. Thus, after a mine explosion, in which the outer surfaces of the lids were deeply burned by the flaming gas, I have over and over beheld almost incredible distortion of the lids, with ulcerating corneæ (due to the lagophthalmos) and blindness. Often plastic operations can advantageously be performed in these cases; oftener, however, operation is refused, and the mining company is likely to be held responsible for the blindness that follows in consequence of the refusal. The various entropium and ectropium operations often find a place, of course, after eyelid burns, as well as electrolysis for distorted eyelashes (traumatic trichiasis).

Injuries to the extrabulbar contents of the orbit, without a complicating injury of the eyeball itself, are quite rare, and yet they do occur. Thus, I have taken from the orbital fat a peach-tree twig two

[1] Pliny (*Nat. Hist.*, Book XI, Chap. 57) declares that, when an eyelid has been severed by a wound, it will not re-unite—a great mistake, of course. However, I have heard the same remark made by an Illinois physician in good standing.

inches long; in another case, a sliver of glass; and, in still another instance, a short ball from a 22 caliber cartridge, without in any of these cases the eyeball being injured. Various disturbances of the ocular motility can be occasioned by injuries of the extrinsic muscles, these amounting at times to complete solution in the continuity of one or more of these contractile structures. Orbital abscess is not infrequent as a result of extrabulbar orbital injuries, especially when these are complicated by the presence of foreign bodies. The great danger, of course, in such cases, is to the optic nerve, which, by reason of cicatricial contraction taking place around it, is prone to undergo atrophy. Disturbances in the motility of the eye may also be occasioned by cicatricial contraction in the neighborhood of the various muscles, or, at an earlier stage, by sloughing of the muscular tissues themselves. Suppurative meningitis is also a possible consequence, or complication, of orbital abscess.

Wounds, with or without remaining foreign bodies, and burns of the conjunctiva, the sclera and the cornea are among the commonest of injuries, and are not infrequently the ground of hard-fought litigation. An incandescent particle of iron will often inflict a wound, produce a burn and leave at the place of injury a foreign substance, all at the same *coup*. Many foreign bodies are expelled by the various provisions of nature looking to this end, while others are removed (sometimes unfortunately so, by reason of the infection introduced) through the instrumentality of fellow workmen. A fellow workman, in fact, sometimes employs his tongue as the removing instrument! Sometimes an eye is struck by a foreign body, which then rebounds away from the eye, leaving, however, a contusion of the cornea (with or without infection) and then an ulcer follows. The workman, in such cases, can hardly be convinced that "there is nothing in his eye." He has so often had a foreign body picked from his cornea, that he has come to believe that a foreign body of some kind, must, as a matter of course, be present whenever his eye is injured. Should the eye be lost, or suffer a material diminution of its vision, the patient's animosity, as well as his attempts at legal redress, are more likely to be directed toward the surgeon than toward the employing company.[1] Burns of the conjunctiva, sclera, and cornea are usually complicated by similar conditions of the lid. They are oftenest produced by steam or burning gas, but now and then take their origin from the action of chemical agents

[1] Much depends on the state of the doctor's finances. Experience shows that the number of suits for malpractice which any physician is likely to be subjected to bears a direct proportion to his financial standing. "Where the honey is, there will the flies be also," is true here as elsewhere.

(the various caustic acids and alkalies) as well as from heated pitch, water, wax, oil, and molten or solid metals, including such explosives as fulminate of silver or mercury, used in percussion caps and boys' torpedoes. They are nearly always of serious prognosis, being in many instances followed promptly by perforation of the globe. Burns by acids and alkalies (oftenest quick-lime) are likely to be not only deep but also complicated by extensive adhesions between the lids and the ball (ankyloblepharon, symblepharon, etc.). In many of the cases the surgeon can afford but little assistance. It should be recalled, to be sure, that partial symblepharon is easily cured by a simple operation. I have seen some cases of ocular burns that promised to be of the greatest severity, but which, nevertheless, gave very good results. Such was a case in which a man had filled a large hole in a base-stone with melted solder, and then, into this molten metal, had tried to set the lower end of a cold iron pillar. He was stooping close down over the stone, guiding the pillar with his hands into the solder-filled socket, when, just as the iron touched the hot solder, the metal splashed up and into his right eye. When he came to me, he seemed to be wearing a metal mask over the right eyeball. This curved plate of metal I had no difficulty in releasing from the conjunctival *cul-de-sac,* and then, behold an eyeball perfectly unharmed, except for a trifling hyperemia! The workman informed me that he had been the subject of this identical accident before, without receiving the slightest harm, and a few months later, he came to my office again with a similar mask of solder before the same identical eye. Once more I removed the metal plate, and once again, I found an uninjured eye.[1] Red pepper, too (so often thrown into the eyes on purpose) though it causes most atrocious pain, is seldom followed by any serious permanent injury.

Such exceptional matters aside, however, the prognosis in burns of the surface of the eye is always very grave, and a final opinion should never be passed till the lapse of several months. Especially after the action of quick-lime or fresh mortar, and the fulminates of silver and mercury, should the prognosis be extremely guarded.

The *iris* is not infrequently involved in wounds of the eye, whether the ocular coats have or have not been opened. In severe contusions (produced, for instance, by a blow of the fist, or a hard snow-ball) the iris is now and then detached at its circumference more or less completely. An incomplete detachment is known as *iridodialysis;* a complete one, as *irideremia,* or *traumatic aniridia.* Detachment is much

[1] Noyes. *Diseases of the Eye,* 1894, p. 288: "Burns by melted metal are often less severe than those due to lime, because when the metal cools it is taken out as a cup, and there is no continuously destructive chemical action."

more likely to occur in the case of irides already adherent to the lens, or the subject of inflammation at the time when the contusion was inflicted. Hence, the prospective expert witness should always enquire carefully as to the existence of these predisposing causes. If the crystalline lens has been dislocated backward (sometimes without such dislocation) the iris may suffer inversion (retroversion, or retroflection)—a condition which often closely simulates iridodialysis and irideremia. The distinction is easily made by the fact that, under the ophthalmoscope, the ciliary processes will, in retroversion, be found to lie concealed, but not in iridodialysis or irideremia. In the latter two conditions, further, there is much more likelihood of considerable hyphemia being present on account of the necessarily ruptured iris tissues.

Rupture of the sphincter iridis without iridodialysis or irideremia, is rare indeed, but has occurred a number of times. It is apt to be accompanied by hyphemia, and is always attended by traumatic mydriasis.

Traumatic mydriasis without rupture of the sphincter iridis, is not uncommon, and is due to paralysis of the sphincter iridis.

All of these affections (except traumatic mydriasis without rupture, which now and then disappears spontaneously) are absolutely incurable.

The loss of earning power consequent upon any of these iris injuries can only be determined in any particular case by actual investigation. Sometimes, even after complete traumatic aniridia, the vision is but very little disturbed; again there may be monocular diplopia, dazzling, etc., those who work much in the dark—e. g., coal miners—are least inconvenienced. If severe iritis or irido-cyclitis follows, the sight may be entirely lost.

Liable to be mistaken for the results of trauma, are the following natural anomalies of the iris:

Heterophthalmos, or difference in the coloring of the irides of the two eyes. I have known such a condition to give rise to a mistaken diagnosis of traumatic iritis.

Corectopia, or *ectopia pupillæ,* or malposition of the pupil.

Polycoria, or more than one pupil in the same eye.

Persistent pupillary membrane, or fetal remains which present themselves ordinarily as fine grayish or brownish threads stretching from iris to lens, or spanning the pupillary gap completely. Such threads are now and then mistaken for posterior synechiæ, but can easily be distinguished from such pathological products by the fact that, unlike posterior synechiæ, they do not spring from the pupillary margin but from a point a little farther out than that, from some point,

in fact, on the *circulus iridis minor* on the anterior surface of the iris. Posterior synechiæ spring either from the margin of the iris or from its posterior surface. Another point of distinction is that under atropin, these threads, or bands, prove to be very elastic; the pupil, in spite of such threads, dilating quite smoothly and round.

Congenital coloboma of the iris is very often mistaken either for an artificial coloboma, or else for a retroflection, or retroversion, of the iris, due, of course, to trauma. In a congenital coloboma, however, the sphincter iridis continues into and round the gap unbrokenly, whereas no sphincter appears in a coloboma due to traumatism or in the gap produced by a folding backward of the iris. Further marks of distinction are: A congenital coloboma is almost always situated below (though exceptions to this rule exist); and, moreover, a congenital coloboma is often, perhaps usually, associated with coloboma in the choroid, the ciliary body and the lens.

A special importance attaches to the differential diagnosis between a congenital coloboma of the iris and an artificial coloboma, or a retroflection, from the fact that eyes afflicted with congenital coloboma are very often partly, and sometimes completely, blind. Therefore, a claimant might readily attempt to attribute to traumatism what was, with him, a natural condition.

Foreign bodies in the anterior chamber and in the iris, usually enter by way of a perforation in the cornea; in very rare instances, they enter sidewise (*via* the lens perhaps) or from the rear. Whether in the iris or the anterior chamber, their presence may be tolerated indefinitely, but, as a rule, they sooner or later set up a low grade inflammation which gradually spreads to the ciliary body and the other intraocular structures with resulting intraocular abscess, or, more frequently, ocular atrophy. The worst feature of such cases, however, is the tendency toward the setting up of sympathetic ophthalmia. Without extraction of the foreign body, prognosis is always grave.

The choroid and the ciliary body when injured, whether or not a foreign substance is left within these structures, present perhaps the most serious conditions with which the ophthalmic surgeon is called upon to deal. Even a slight contusion upon the eye may cause a hemorrhage from the structures (especially in anemic persons, or those who are suffering from arterio-sclerosis or high degrees of myopia) and the extravasated blood may collect between the choroid and the sclera, or else, which is much more serious, between the choroid and the retina. Sometimes the hemorrhages are slight and promptly absorb. In such cases the vision does not suffer. Oftener, however, the choroid is detached, or the retina, and then the eye is almost invariably

lost—in the former event from irido-choroiditis, and in the latter, from the tendency which any detachment, however slight, of the retina, displays, to become complete.

Ruptures of the choroid are generally situated between the optic disk and the macula lutea. In the simpler cases, the vision, which immediately after the injury is nearly always bad, rapidly improves, but scotomata are nearly always left permanently, and a perfect result is the very rare exception. In the graver cases, the sight is nearly always permanently lost, owing to detachment of the retina, hemorrhage into the vitreous and other complications.

Perforating wounds of the ciliary body, if they lie in a direction parallel to that of the ciliary folds, are often of good prognosis; if, however, they lie diagonally across the folds, or transversely, the eye is generally lost by atrophy, and there is in such cases a marked tendency toward sympathetic involvement as well.

In case a foreign substance is left in the ciliary body, the prognosis is, of course, even graver.

The *retina* alone is hardly ever injured, for penetrating wounds of this membrane of course involve some of the other structures necessarily; while even a rupture of the retina, produced by a contusion, is likely to be accompanied by solutions of continuity in the choroid. Retinal ruptures produced by contusions nearly always occur by *contre-coup*.

The slightest of all the injuries of the structure in question is known as *commotio*, or *concussio, retinæ*. The retinal changes which are designated by this name have been mistaken for retinal detachment, and, as they nearly always undergo perfect resolution and that very quickly, they are hence important in a legal viewpoint. The distinction between concussion and detachment is made by the following signs: In concussion the retinal vessels are wholly undisturbed, showing no parallactic movement or increased hypermetropia, the opposite state of affairs presenting itself in retinal detachment. Further, in concussion, the retinal plications, or folds, occurring in detachment, are absent. Finally, a concussion (which is always recent) is never quite so white or so opaque as a recent retinal detachment.

Other forms of retinitis than the relatively unimportant *concussio*, are far more serious. Such, for instance, are the *retinal changes at the macula lutea*, neither commotio nor detachment, following contusions of the globe and nearly always serious and permanent. In fact the visual disturbance, being macular, is well-nigh always incapacitating, so far as the earning power of the injured eye is concerned. An important matter to remember is that the changes in question are of very

slow development in the vast majority of cases, weeks being required in some instances before the visual difficulty appears. In such cases, of course, the question often arises, especially in court, why was it that, if the eye was so severely injured as is claimed, the plaintiff did not observe the fact until several weeks after the accident—until, indeed, other persons perhaps had found it possible to recover for *their* injuries received at the same place and at the same time?

Hemorrhage confined to the retina is generally of little import permanently. There is often for a time, especially if the bleeding be central, erythropsia and metamorphopsia. Whether central or not, a hemorrhage is almost always accompanied by a scotoma. These appearances, however, provided the extravasated blood does not break its way into other structures, are very evanescent.

Detachment of the retina, however, may occur in consequence of large effusions of blood, though oftener by far it is produced primarily by contusions or perforations of the globe. Occasionally the retinal separation is consequent (at a late date) upon the contraction of cicatricial tissue, either in the vitreous or in the retina itself. Extensive loss of vitreous is not infrequently responsible for its production. The amount and kind of visual disturbance depend, of course, upon the extent and situation of the retinal detachment. Contraction of the visual field and scotomata correspond pretty closely to the portions of the retina that are detached, and metamorphopsia (distorted vision) together with erythropsia (red vision) in the case of hemorrhages, is apt to precede the formation of the blind areas, and to diminish *pari passu* with the increasing blindness.

Prognosis is always bad, although traumatic detachment of the retina is oftener followed by complete recovery than are the other varieties.

The *crystalline lens,* as a result of traumatism, may undergo displacement (luxation or subluxation) or be rendered opaque (traumatic cataract) or become the seat of a foreign substance. Luxation, partial or complete, may be the result of a penetrating or rupturing wound of the eyeball, or merely of a contusion or compression of the eye. It is said to have happened as a result of concussion sustained by the skull, and even by the neck and the feet (as in falls from a height). Even in partial dislocation there is loss of accommodation and sometimes monocular diplopia. In backward dislocations, the iris becomes tremulous (iridodonesis) by reason of loss of the normal support which is afforded the iris by the lens. In case the lens is so displaced as to lie with its margin across the pupillary area, one part of the eye may be extremely hypermetropic and the other myopic. Complete disloca-

tion into the vitreous means, refractionally at least, aphakia (as after a cataract extraction) hence an extreme degree of hypermetropia—unless, indeed, the eye was very myopic to begin with. In some cases of partial dislocation, the diagnosis can only be made after atropinization and then by means of the ophthalmoscope. Forward dislocations are sufficiently obvious even to beginners in ophthalmology.

It should be remembered that displacement of the lens is now and then congenital. Thus, P. H. Adams, of Oxford, England, reports the case of a family with congenital displacement of the lenses, in which the mother and seven out of nine children suffered from this condition.[1]

Partial dislocations can sometimes be remedied, though never fully, by means of spectacles. Even then, however, the great difference in the refraction of the two eyes (anisometropia) renders impossible the simultaneous employment of both organs, and hence the victim of the accident is rendered monocular to all intents and purposes, except that he possesses in the vision of the injured eye a moderate reserve of sight to draw upon in case the fellow organ should go blind from any cause at some time in the future.

Complete dislocation into the vitreous does not call for extraction, or other form of operation, unless productive of irritation. Glasses prove of benefit in this condition under the same conditions, as a rule, as in partial dislocations. Complete dislocations forward—i. e., into the aqueous, is so often followed by chronic glaucoma, lenticular opacity (cataract) and adhesions to the iris and cornea that, in the great majority of cases, extraction of the lens is necessary. In any case of dislocation of the lens, forward or backward, partial or complete, the lesion is apt to be followed by lenticular turbidity (cataract). This may render operation necessary at a later date.

Traumatic cataract without lenticular dislocation is often a consequence of injuries to the eye, accompanied or unaccompanied by perforation or rupture of the ocular tunics. If entirely uncomplicated, these cases can usually be conducted to a successful termination (the younger the subject the greater the probability of success) so far as respects the injured eye alone. However, the eye can never be employed to advantage simultaneously with the fellow organ, excepting only in the extremely rare instances where the fellow eye was already aphakic or extremely hypermetropic.

A foreign body in the crystalline lens means, as a rule, progres-

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[1] Report of June meeting of the Ophthalmological Society of the United Kingdom, *Medical Press*, June 25, 1909, abstracted in *Ophthalmology* for Nov., 1909, Vol. VI, No. 1, p. 105.

sive opacity of that structure. A wide pupil and oblique illumination are often prerequisite to the discovery of the intruding substance. In my experience, small foreign bodies in the lens, if not amenable to a magnet, are better left alone, for, now and then, the expected cataract never develops, and the patient retains an extremely useful organ, whereas, if necessary, operative interference can be instituted at a later date. Much depends, of course, upon the extent of the injury suffered by the lens, and on the character (as regards probable asepsis, etc.) of the offending substance.

Wounds of the vitreous humor are not as a rule important, except so far as they imply an injury to other and more irritable structures—the retina, the choroid, etc. In other words, simple compression or contusion of the eye, seldom results (owing to the elasticity of the vitreous) in serious injury to the vitreous humor, excepting when a hemorrhage from the coats of the eye, breaks through the limiting membrane (hyaline membrane) or when an exudate is poured out into the vitreous from the ocular coats. In cases of hemorrhage into the vitreous, the outlook, though not hopeless, is bad. I have seen in young patients, after moderate hemorrhage, complete recovery in every portion of the field; but, in the vast majority of cases, positive scotomata, movable or immovable, remain, impairing the sight and earning power according to their extent and to the parts of the visual field to which they correspond. In cases of exudate, connective tissue bands are formed in the vitreous, and these, contracting, cause detachment of the retina and choroid, together with atrophy of the eyeball.

When the coats of the eye are perforated, hemorrhage and exudate into the vitreous are far more likely to occur, together with retinal and choroidal detachment, and, in addition, there may occur an intraocular abscess. Prognosis depends on the site of the injury, the presence or absence of infection, the quantity of exudate or blood poured out, the amount of vitreous which has escaped from the eye, and, finally, on the presence or absence of a foreign body.

Foreign bodies in the vitreous may arrive in that humor after a journey through almost any part of the enveloping membranes. Perhaps most frequently they pass through cornea and lens; often, however, through sclera, choroid, and retina. They consist, for the most part, of bits of metal and stone, but particles of coal, wood, and other substances have often been found in the vitreous.

Diagnosis is often difficult. There may manifest themselves at once by scotomata and peripheral contractions. Sometimes the path which has been taken by the offending substances can be discerned, either by the naked eye (lateral illumination should be employed) or by means

of the ophthalmoscope; this, again, may be impossible, owing to a great variety of circumstances. Sometimes the ophthalmoscope reveals the foreign body with much distinctness, often, however, the quantity and situation of the hemorrhage forestalls even the haziest kind of view. Air bubbles in the vitreous are highly suggestive, but not absolutely pathognomonic, for they may occur even when the coats of the eye have not been perforated. Magnetic needles have been devised for the purpose of detecting the presence of metals which, like steel and iron, exert an influence upon magnetic substances. The giant magnet is, with regard to such particles, both an excellent means of diagnosis and a splendid instrument for removal. In very many cases, too, the X-ray gives valuable information; in fact this agent, in a very large number of instances, is undeniably our most reliable means for the detection of foreign substances in the eye. A decided advantage is that many substances not susceptible to magnetism (and therefore not responsive to the needle and the magnet) are very plainly revealed by it—for instance, certain kinds of glass,[1] though unfortunately, not wood. For the technique required when magnetic needles or the X-ray is employed for the purpose of detecting foreign bodies in the eye the reader is referred to the appropriate portions of this *Encyclopedia.*

The foreign body should, when possible (especially if possible without too great disturbance of the intraocular tissues) be extracted. In no case, however, should the operator merely go "a-fishing" in the eye. In the case of substances susceptible to the action of magnets, such a removing instrument may be employed at times with very conspicuous success. In any case, however, even after the apparently successful removal of the foreign substance, the prognosis should be guarded, for, even in such cases, there may follow such cicatricial contraction that the eye, after a time, is absolutely worthless. If the foreign body is septic in character, the eye is nearly always lost, whether the foreign body is or is not successfully extracted.

Suppose the foreign body is allowed to remain within the vitreous. What, then, is the prognosis? If the body be septic or oxidizable, the eye is lost almost as a matter of course. Sometimes, on the other hand, aseptic and non-oxidizable foreign bodies in the vitreous, are tolerated indefinitely, with or without encystment. As a rule, however, even bodies of this class sooner or later occasion iritis, cyclitis, and a plastic form of hyalitis, followed by contraction of the bands of exudate, and then sets in detachment of the retina, with, perhaps, a

[1] Depending on the chemical composition of the glass. Tivnen (*Ophth. Record,* xxiv, 12, p. 640) says: "Generally speaking, the localization of glass in the eye by the X-ray is very disappointing."

shrinking of the eyeball. The general health may suffer, and, as a last chapter in this melancholy history, there may follow sympathetic ophthalmia.

For the amount of damage done to the earning capacity by the various forms of ocular injury, the reader is referred to a later section of this division, entitled *"Visual Economics."*

Simulation of ocular injury or disease.

By *simulation* we understand the feigning of an ocular injury or disease which does not at all exist; by the *false attribution* of an injury or disease, the assignment to an actually existent disease or injury of an untrue cause; by *exaggeration*, finally, the pretense that a certain injury or disease which does actually exist (whether the cause assigned be true or false) is of greater extent or severity than is really the case.

Closely related to these is *dissimulation*, or the pretense that an actually existent disease or injury does not exist.[1]

All these forms of falsification, excepting the last-named only, either with regard to the eyes or to other organs, are very common—a fact that has been stated in almost every work on legal medicine with such a fullness of detail that the subject has actually been worn threadbare. However, to exemplify briefly with regard to the eye and with respect to simulation only: School children attempt to escape from their school room duties by pretending that their eyes are painful.[2] Soldiers and sailors seek to avoid military service by pretending blindness, partial or complete, in one or both eyes. Pensioners have been known to simulate. Hysterical people, in order to excite either wonder or pity, often feign blindness. Finally, workmen in factories and mines, and passengers on, and employes of, railroad and steamship lines, often endeavor, after an accident, to produce on the mind of the examining expert the impression that their eyes are injured, though not the slightest harm has really been produced.

Of all the diseases of the eye which are feigned absolutely, i. e., simulated—where the lie is, as it were, "made out of whole cloth"—the commonest are amblyopia and amaurosis. Next to these comes kopiopia, or the rapid exhaustion of vision; and, finally, there come concentric contraction of the visual field and scotomata. These four

[1] Simulation, false attribution, exaggeration, and even dissimulation have all been enormously increased in Europe, and to some extent in the United States, since the passage of the various "Workmen's Compensation Laws." For a notice of such laws, see, under the names of the different countries, the division of this section entitled, *"Ophthalmo-Sanitary Legislation."*

[2] The Germans have a word *Schulkrankheit*, by which they designate any feigned illness.

troubles, of course, when actually existing, can be exaggerated also, but, owing to the precision with which the condition of the visual apparatus can at the present time be determined, it is practically impossible to simulate any other affections of the eye than just these four. Almost all other diseases must show some actual pathological changes, in which event, of course, there is possible, in the way of falsification, merely exaggeration or else the assignment to the pathological condition of an untrue cause.

Tests for the simulation of concentric contraction of the visual field and scotomata.—This sort of simulation, though very rare indeed, has yet been known to be practised. The commonest form is that in which it is pretended that there is mere concentric contraction of the field. The contraction is generally feigned to be of high degree, as otherwise the injury to the earning power would be too slight to constitute a ground for heavy damages. The very existence of central scotomata, ring-shaped scotomata, and hemianopic defects, is wholly unknown except to experts. Possibly an expert might hope to simulate defects like these with a moderate chance for success. Expert or layman, however, the claimant should be examined on various days, or at least occasions, and the separate results should be written down and carefully compared. By taking the size of the field as a whole, and also the size of the various scotomata (if any are alleged to be present) at various distances, almost any malingerer with regard to the matters in question, can surely be exposed. It should be remembered, however, that in cases of hysteria (an affection that is often alleged to be of traumatic origin, as after a railway accident) the contraction of the field and the various other scotomata do not remain the same throughout the test, even in genuine cases.

Tests for the simulation of kopiopia.—Kopiopia is almost always due to errors of refraction, to paresis or paralysis of the ciliary muscle, to various affections of the extrinsic muscles, or to neurasthenia or hysteria. In all such cases, of course, the physical signs of the various disorders mentioned will be present, and there can be but little chance of error. Sometimes, however, rapid exhaustion of the eyes does really occur as an isolated symptom, and then the question of malingering or no malingering is very hard to answer. Repeated testing, from the nature of the affection, is of very little use. Continued observation is now and then serviceable; but, occasionally, actual detective work should be resorted to by those in charge of the defense. Sometimes a little investigation of this kind discloses wonderful matters. For instance, it may show that the supposedly kopiopic person is spending a considerable number of his hours in writing or reading. Again, a

simulator may at times, for an attractive wage, consent to copy fine print for many hours daily, or nightly, especially if the place of working is such that he believes he will not therein be subject to damaging observation.

Tests for the simulation of amblyopia and amaurosis.—Where amblyopia or amaurosis is feigned, the affection is almost always declared to be unilateral; nevertheless, for the sake of convenience, we shall treat first of the very rare instances where blindness is alleged to exist in both eyes. We depend, in such cases, very largely on the presence or absence of the pupillary light-reaction. If the pupil acts quite well to light, the claimant is probably malingering. However, a word of caution is necessary as to this, for, in a very few instances of actual amaurosis (i. e., where the lesion is situated high up in the optic tract) the pupillary light-reflex is retained unimpaired. On the other hand, one should always bear in mind that cases exist in which the pupil does not react to light, though light perception is present. Then, too, some persons possess the power of contracting or dilating the pupil at will, while, finally, the presence of posterior synechiæ accounts for the immobility of some pupils.

The way in which the pupillary light-reaction should be tested is this: The claimant, by ordinary diffuse daylight, is caused to face directly a window, and to gaze at a distant object, the while he holds a hand across the eye that is not under examination, in order to exclude the light therefrom. The examiner then first notices the size of the pupil in the eye that is being tested, and then excludes the light therefrom (by holding a hand across it) for as long as five or six seconds. On removing his hand, the examiner will find, in case the light-reflex is normal, that the pupil has considerably enlarged. The enlargement, or dilatation, remains for about half a second, and then is followed by a very decided contraction. This contraction is succeeded by a moderate dilatation, and that by a still more moderate contraction, until at last the pupil becomes stationary in a condition of more or less moderate contraction, according to the intensity of the ilumination. By the rapidity and the amplitude of these pupillary excursions the examiner decides as to whether the light-reflex is normal or abnormal.

All the conditions of the test, however, as above laid down, should be carefully complied with. Thus, if the examinee stands with his back, instead of his face, toward the window, the illumination may not be sufficient to affect the pupil visibly, even if the light-reflex be normal. Again, if the eye that is not under examination be not excluded from the light, the illumination that enters that eye will affect the pupil of the fellow organ through the so-called "consensual" light-reflex. Still

further, if the examinee's gaze be not directed at a distant object, then the contraction of the pupil which results from, or at least accompanies, convergence and accommodation, will suffice to confuse the examiner.

To exclude the possibility of error through posterior synechiæ, the pupils of both eyes should be subjected simultaneously first to high and then to low illumination. In proper cases (i. e., in young subjects and where there is no suspicion of glaucoma) atropin may be resorted to, and is generally conclusive.

Then, too, there are other tests. Dilatation of the pupils being an almost constant result of amaurosis, the absence of this symptom is exceedingly significant. True it is that dilatation can be produced artificially, e. g., by means of atropin or cocain; but such a factitious mydriasis can easily be detected by the fact that, in nearly all such instances, the mydriasis is nearly or quite *ad maximum*. Complete dilatation *ad maximum* would indicate the combined employment of atropin and cocain.[1] Shrewd malingerers often use a weak solution of the drug, or defer the appearance for examination until the pupillary dilatation has somewhat subsided. *Schmidt-Rimpler's test* for the simulation of bilateral amaurosis is this: The examiner directs the patient to look at his own hand. A malingerer, especially if ignorant, will now and then look purposely elsewhither than at the hand, although, as a matter of fact, a person who has been blind, whether for a short time or for a long one, experiences no difficulty whatever in fixing either of his hands with the visual axes. The Schmidt-Rimpler test has been somewhat modified by Burghardt, who suggests that the claimant be requested to put out the forefinger of one hand, and then touch that finger with the forefinger of the other hand. People actually blind, experience no difficulty in doing this. Quite important as a test for amaurosis (especially if declared to be of long standing) is the staring, fixed, unmeaning, look of the eyes, which is very soon acquired by those who are truly blind, and with which the experienced oculist cannot help being familiar. Not quite so important, and yet of some significance (because more likely to be overlooked even by a coached malingerer) is the short-stepping of the truly and totally blind, together with the upward turning of the face, and a generally "listening" expression. Repeated tests made with test-cards ending in lines of different-sized type on the different days, or occasions, of testing (*e. g.*, Snellen 40 on one occasion, Snellen 20 or 10 on another) will now and

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1 "The mydriasis produced by the simultaneous action of atropin and cocain is the most considerable that can possibly be attained."—Fuchs, *Text Book of Ophthalmology*, New York, 1893, p. 259.

then suffice to expose the simulation of bilateral amblyopia, the malingerer believing that, on each occasion, he should, to be consistent, leave off reading at exactly the same number of lines from the bottom of the card. Further, it is always a ground for the greatest suspicion when the claimant, in reading aloud the test type, declares that he can read no further, although, thus far, he has made no mistake in identifying letters. A strictly honest reader will almost invariably miscall the hardest letters (for instance B and S) in one line, before declaring his total inability to read any of the letters of the next. Again, if he miscalls only certain letters in a line, and these are the easiest letters in that line (for instance T and L), this is also ground for some suspicion. However, it should be remembered that even ordinary patients, who, for instance, are being tested for glasses, will now and then abruptly stop and declare their inability to read further, though, up to that moment, they had not miscalled a single letter. In the case of such patients, however, repeated urging will invariably bring about the reading of still finer lines of type and the customary irregular and gradual, instead of sudden and even, fading away of the power to read on. It is also well enough to note that the influence of astigmatism should be excluded before the failure to read easy letters while harder ones are recognized, should be regarded as suspicious. Not infrequently (in the case of unskilled malingerers, who, of course, constitute the largest class) the replies of the examinee, while he is being tested, are manifestly absurd. For example, he may allege that a weak lens, or even a flat glass, improves his vision greatly, or ''magnifies'' the letters very much. A + 1.00 D. S. ''seems to feel good'' to the eye, while a + .50 D. S. causes extreme pain. Threatening movements toward the claimant (accompanied by the greatest caution neither to make a noise nor to set in motion a current of air—noises and air-currents often alarming patients truly blind) will occasionally throw a claimant off his guard; and, in one instance, I detected a malingerer merely by ''making a face'' before him—the suddenly altered expression of the claimant's countenance being quite sufficient evidence that he had seen. A peephole through which the alleged amaurotic subject could be observed from a neighboring apartment is often an instrument of scientific precision, if not of dignity. Sometimes, from such a coign of vantage, the claimant will be observed to take up books and papers, and examine them critically. In very many instances, however, nothing suffices but protracted observation, especially in cases of simulated amblyopia, in which condition, of course, the presence or absence of mydriasis and the presence or absence of the pupillary light-reflex are very much

less to be depended on as tests for malingering than in cases of simulated amaurosis.[1]

Finally, it should always be borne in mind that the mere allegation of amaurosis or amblyopia is in itself a suspicious circumstance (particularly if unaccompanied by evidence of renal alteration) for the very simple fact that blindness, partial or complete, non-congenital, not due to refractive errors, or corneal, aqueous, or lenticular obstructions, and, furthermore, presenting no ophthalmoscopic changes whatever, is exceedingly rare. Occurring in connection with a claim for damages, an allegation of blindness, without the presence of a single supporting objective symptom, is a proper ground for suspicion of very high degree.

The simulation of unilateral amaurosis and amblyopia is very much easier to detect than is the bilateral variety of simulation, although (as has been stated *supra*) it is much more commonly practised. The following methods of detection have been chosen by the present writer as being of especial value in legal cases.[2]

The method of Cuignet.—Direct the claimant to read, at the same time to hold quite still both his head and the reading-matter. Insert a pencil vertically between the eyes and the book. If the patient continues to read uninterruptedly, he is undoubtedly seeing with both eyes, because, did he not see with one eye such letters as were quite invisible to the other (on account of the pencil intervening between that other eye and those letters) he could not read them. This test is by no means infallible, being absolutely worthless, indeed, in the case of all malingerers who have been thoroughly coached about it. Such malingerers can easily refuse to read all such words, or portions of words, as are overlaid by that particular "ghost-pencil" (there are, of course, two of these) which stands on the side of the sound eye. Further, the examiner must, in any case, be absolutely certain that both the claimant's head and the reading matter are kept absolutely unmoved. Otherwise, a claimant may seem to be malingering when, in fact (by moving his head or the book a trifle) he is really doing his best to read across the page continuously. A page consisting only of letters unrelated in sense is preferred by some examiners, for the reason that when such a page is employed, an innocent examinee will not be able

[1] In fact, simulated bilateral moderate amblyopia is the hardest kind of important ocular malingering to expose.

[2] A rather large number of tests should be familiar to the expert, because some tests may easily enough be rendered useless by reason of the claimant having been very thoroughly coached concerning them. Also, the expert can better withstand a cross-examination when he has used a considerable number of methods.

to appear guilty, merely by being able to guess that the words, or parts of words, are, which, to him, are really covered by the pencil.

One of the best points about this test (legally considered) is that it can be easily understood and even repeated to his own satisfaction by the average juryman.

The method of Alfred Graefe.—Have the claimant hold the professedly bad eye closed. Then set before the sound eye a prism in such a position that the thick edge thereof extends horizontally across the pupil. The claimant, of course, sees double—a fact he will readily admit, because, so far, the professedly unseeing eye has not been called in question. Then let the claimant uncover the "unseeing" eye, at the same time that the examiner slightly moves the prism in such a way that the sound eye cannot now possibly see double. If the patient still sees double, he is seeing with the eye which he before declared to be blind. The prism employed in this test must of course be strong enough (say 10°) to insure that double vision will necessarily result after the second eye has been uncovered—assuming, of course, that the second eye is possessed of sight.

This test has an especial advantage in that, unknown to the claimant, the visual acuity of each eye can be accurately determined. This is accomplished by having the claimant read aloud first one, then the other, of the twin images. It can also be understood by a fairly intelligent juryman.

The test is also carried out in an even simpler form. The examinee is permitted to look with both eyes. The physician places a 10° prism, base up or down, before the sound eye, and, if the claimant admits to seeing double, he is seeing with the alleged blind eye, as well as with the sound one. The difficulty is, however, with this simplified form of the test, that the claimant, because his alleged blind eye is manifestly under examination, will not invariably confess to seeing double He is much more likely to do so with the test in the regular form.

The crossed diplopia test.—This also is a test carried out by means of a 10° prism. Place the prism, base out, before the alleged blind eye. If that eye sees, it will make an excursion inward, involuntarily, for the sake of single vision. Of course, if it does not see, it will not perform this movement. This test is easily demonstrated to the average intelligence.

Method of Vieusse.—On a plain stereoscopic card are fastened two wafers of different colors—one red, for instance, and the other blue—at a distance in the case of each wafer, of ½ centimeter from a vertical line dividing the card into halves. When so small a distance—only 1 centimeter—separates the wafers, the wafer which is on the right

side of the card appears, when the card is looked at through a stereoscope, to be on the left, and the wafer which is on the left half of the card appears to be on the right. The card is placed in a stereoscope, and the instrument handed to the claimant with the request that he look at the card through the instrument and inform the examiner as to what it is that he sees. If he admits that he sees both wafers, then, of course, he is seeing with both eyes. If, on the other hand, he confesses to seeing one wafer only, he is asked to state the color of that wafer. He will almost certainly, if malingering, name the color of the wafer which appears to be on the side of the sound eye. By so doing, he of course, unmasks himself completely, for the wafer that appears to be on the side of the sound eye is the one which is seen by the eye that he alleges to be blind.

Perhaps a better way is to have a horizontal line on one of the halves of the card, a vertical line on the other, these lines occupying such positions that, when seen through the stereoscope by a pair of sound eyes, they appear to form a cross. If, then, a person really blind in one eye, looks through the instrument at this card, he will see either the horizontal line only, or else the vertical line only. If he admits to seeing a cross, he is malingering, of course. Any juryman can understand this test.

The method of Harlan.—Have the claimant cover with his hand the alleged unseeing eye. Place before the sound eye a + 6.00 D. S. glass. This eye is now artificially myopic, and can read (assuming that the eye is emmetropic naturally) fine print at a distance of 6½ inches at the very farthest. Place a card of fine type very close to the eyes, and have the claimant release the injured organ. Ask him to read aloud, and then, as he does that, slowly remove the card from the eyes, until a distance greater (to be perfectly sure, some inches greater) than 6½ inches, is intervening between the claimant and the card. If the claimant still reads, he is doing this solely by means of the eye which he had previously declared to be blind.

This test is also employed in a slightly different way. The claimant, when the test is applied in this modified form, is not requested to cover the alleged bad eye at all, but, at the very outset, there is placed before both his eyes a trial frame containing a + 6.00 D. S. lens for the sound eye and a flat glass (or, what amounts to the same thing, a + .25 D. S lens) for the other. The claimant is then requested to read the distant types. Believing that he has about the same sort of glasses before each eye, the examinee very often proceeds to read, thus, of course, demonstrating the fact that he is seeing with the eye which he alleges to be blind.

By the suppression of technicalities, this test can be made very clear to the average jury.

Method of Jackson.—Place before the eye supposed to be blind a + 4.00 D. S. lens and before the sound eye a + 2.00 D. S. The *punctum remotum* of the first eye will now be 25 centimeters; of the other, 50 centimeters. Hand the claimant a card of fine type and ask him to read. If he selects as his reading distance 25 centimeters, instead of 50, he is malingering. A good, court-proof test.

Method of Snellen.—This method requires the possession of test-types alternately red and green upon a black ground, and a pair of spectacles in which one glass is green, the other red. Through the red glass only the red letters, not the green, are visible; and correspondingly, through the green glass, only the green letters and not the red ones, can be discerned. If the claimant reads all the letters indiscriminately, he is reading with both eyes. A test that is promptly and universally intelligible and even demonstrable.

Method of Nettleship.—Instill one drop of a 2 per cent. solution of atropin into the *sound eye*—preferably after cocainization. Then bandage *both* eyes for one hour. Place in the claimant's hand a card of fine type, remove the bandage, and request him to read aloud. If he reads, he accomplishes that feat by means of the blind eye. This is theoretically an excellent test, but, in practice, I have found it difficult of employment, because the claimant not infrequently objects to having "medicine" put into his sound eye. Hematropin I have also found much preferable to atropin, because, the claimant being naturally somewhat hostile to the examiner, is apt to view with much alarm the week of actual blindness in the sound eye resulting from the use of atropin. There is also ever present, whether homatropin or atropin is used, the remote possibility of relaxing in this, the sound, eye a long-existing spasm of the ciliary muscle covering a high degree of hypermetropia, and then of the spasm not returning when the otherwise transitory effects of the atropin have passed away. In such a case, of course, the hostile claimant can hardly be convinced that he has not been seriously injured in the sound eye by the examiner, and a suit against the examiner in which the defendant in the original suit (or claim) may or may not be joined (according to whether he can or cannot be regarded as a principal, under whom the examiner was acting as agent) may follow. In any case, to use this test successfully, the examiner must make sure (preferably after the claimant has admitted his ability—or denied it—to read) that relaxation of the ciliary muscle in the sound eye and consequent inability of that eye to read fine type has actually occurred.

None of the numerous tests for malingering which require the use of complicated apparatus (such as Worth's) or a deep understanding of optical principles, possesses half the value in a law court of a simple and generally intelligible test, such as any one of those above described. A juryman feels on surer ground, when he understands precisely how the fraud in question was exposed.

In addition to these more particular methods, almost any one of which will suffice in the vast majority of cases, the state of the pupil as to light-reflex and dilatation should be carefully interrogated. And, by the way, when testing the light-reflex in a case of alleged unilateral amaurosis, we should never forget to examine the consensual light-reaction, since this is a means of determining whether the non-response to light in the pupil of the alleged bad eye is, or is not, due merely to posterior synechiæ. The way in which to test the consensual light-reflex is this: The pupil of the eye to be tested is alternately exposed to and excluded from the light, while the effect of so doing is watched in the second eye. If the second eye (being itself healthy) does not respond to the alternate screenings and exposures of its fellow, then the absence of the light-reflex from that fellow eye is not due to posterior synechiæ. It is to be observed that, in unilateral simulation, as well as in bilateral, the malingerer not infrequently resorts to the factitious mydriasis producible by means of atropin or cocain. In this connection it should be remembered that, when only one eye has been atropinized, the pupil of the other eye is narrower than normal, because of the consensual light-reflex being excited unduly by means of the unaccustomed quantity of light which enters the atropinized eye. Sometimes the pupil of the second eye is found abnormally enlarged, because of some of the atropin solution (or at times even some of the tears from the atropinized eye) having been inadvertently introduced into the admittedly sound eye. The admittedly sound eye may also present a dilatation due to the fact that so much of the atropin solution has been used in the professedly amaurotic eye that the general effects of the drug (which include, of course, a dilatation of the pupils of both eyes) have been evoked. In unilateral malingering, however, as well as in bilateral, it may, in case the claimant be a man of shrewdness and understanding, become absolutely necessary to resort either to espial or to protracted observation—the claimant, after a few weeks, or while away on a visit, neglecting to keep the pupil of his "blind" eye dilated. Threatening motions (care being taken, as before, to guard against the production of noise and air currents) and also the making of faces can be employed in unilateral malingering, as well as in bilateral, by first placing a bandage over the sound eye, or directing the claimant to hold

a hand across it. One of the best of the threatening motions consists in making as if to poke a finger into the eye.

The false attribution of ocular injuries or diseases.

The false attribution of ocular injuries or diseases (by which we mean, as before stated, the assignment of an untrue cause to a real injury or disease) is, like simulation, very common. On the other hand, unlike simulation, it is often accompanied by exaggeration. (Exaggeration can also exist without false attribution.) In fact, false attribution is much more common than simulation, for the reason that this particular form of falsification can be applied to a vastly wider range of injuries than can the latter description of malingering. Simple simulation indeed, is, as a rule, from its very nature restricted to kopiopia, to concentric contraction of the visual fields and scotomata, and to amblyopia and amaurosis, while fraudulent attribution can find full play and opportunity in well-nigh every conceivable form of ocular incapacity, and, moreover, almost always has objective symptoms to give it plausibility.

To take a few examples: A man is afflicted from childhood with strabismus. After a railway wreck, he alleges that certain injuries received by him at the time of the accident are responsible for the crossing of the eyes. A woman has congenital colobomata of the irides. After falling through a defective sidewalk she declares that since the injury, she has had no sight whatever, and she offers the colobomata as objective evidence that her eyes were actually injured on the occasion of the fall. A man afflicted with detachment of the retina due to extreme myopia, seeks, some day, to ascribe his diseased condition to the undue force with which he was ejected from a room in which, against the protests of the proper occupants, he was endeavoring to sell goods. A man on whom a charlatan was ''operating'' for the removal of a ''cancer'' from the eyelid, received upon the pupillary area of the cornea a drop of some sort of acid. A dense leucoma formed, with the total abolition of qualitative sight, and, some six years later, the victim sought to prove that the corneal opacity had been developed in consequence of an injury received in a mine. Such are a few of the almost infinite forms and varieties which fraudulent attribution assumes in connection with injuries to, or diseases of, the eye.

In discussing these various forms and varieties we divide our subject into:

1. Injuries affecting the eyelids and eyebrows. 2. Injuries affecting the conjunctiva and cornea. 3. Injuries affecting the iris. 4. Injuries affecting the lens. 5. Injuries affecting still deeper portions of the eye.

1. *Injuries affecting the lids and eyebrows.*—With respect to the false assignment of causes in the case of injuries to these parts, it is always necessary, of course, to consider the nature of the wound or wounds in relation to the cause assigned. It will often occur that the cause assigned could not possibly account for the appearances produced. On the other hand, the examiner must be cautious not to declare as impossible a cause which, after all, is really the true one. Thus, as stated already, under the heading of "The commonest injuries with which the ophthalmo-surgical expert has to deal," I mentioned the very deceptive appearance which is often produced by contused wounds of the eyebrow, these wounds not very infrequently seeming to have been produced by a knife, axe, or other cutting instrument, though produced in fact by the fist. I also indicated the great importance attaching to a correct distinction between contused wounds and incised wounds in this portion of the body, persons often being accused of assault with a deadly weapon, or intent to kill, when, as a matter of fact, they are wholly innocent of such a high-grade crime.[1] The distinction is easily made, as may be recalled, by means of the following signs: 1.—A contused wound is the far more likely to present an areola of ecchymosis. 2.—Under a lens, the walls of a contused wound are seen to be not actually smooth, but more or less ragged. 3.—While an incised wound shows all the tissues divided just as deeply down as the wound reaches, a contused wound mimicking an incised wound, shows some of the fibers of the more resisting tissues undivided, while others, deeper down in the wound, are severed. 4.—The really contused, though apparently incised, wound is generally more extensive (longer) at the bottom than at the surface, while the really incised wound is apt to possess a so-called "tail" both at the beginning and at the end—in other words to be of greater extent in the skin than in the deeper tissues. This distinction is due to the fact that, in the really incised wound, the inflicting instrument cuts from without inward, whereas, in the case of a wound of the contused variety, the incising instrument—the bone—cuts from within outward.

It is always worth remembering that not infrequently a claimant is honestly mistaken as to the nature of the weapon with which his wound was produced. Thus, he may, reasonably enough, have seen a flash from a ring or a cuff-button, worn by the assaulter, and, later, observing the apparently incised nature of the wound, have come to

[1] It is owing to the great importance of this distinction that the matter is given some treatment under the present head as well as under that of "The commonest injuries with which the ophthalmo-surgical expert has to deal."

the conclusion (more or less unconsciously perhaps) that what he has seen was the flash of a knife. He will then, almost to a certainty, declare (and of course with the utmost honesty) that he saw a knife in the hand of his assailant, or even, in case he happened to be possessed of a rather active imagination, that he saw the assaulter ''draw'' a knife.

As an instance of the opposite state of affairs, i. e., when it appears from the look of the wound that a knife could hardly have been employed, although, as a matter of fact, a knife was the actually inflicting instrument, I refer to the rather rare instances where a single sweep of a knife across the eyelid has occasioned a zigzag wound, presenting a torn—the so-called ''lacerated''—appearance. This phenomenon is due to the fact that the knife, before it cuts, stretches out the very extensible skin before it and then parts the tissues. When the skin goes back into place, the appearance is that of a V or a Z, as if a hook or some such object had engaged in the skin of the lid and then torn it in two or more directions, or perhaps had engaged more than once in the skin. In the case of wounds like these, the question sometimes takes the form, not as to whether a knife was the actually inflicting instrument, but as to whether a knife which is admitted to have been employed for one single stroke, was not really used again and again, the answer to this question having an important bearing on the legal inquiry as to whether (in case the user of the knife was acting in self-defense) the self-defender did not, by the employment of ''excessive force,'' become in his turn (from the legal viewpoint) the aggressor.

Wounds of the eyelid are sometimes produced voluntarily, with the intent to ascribe the injury to an accident or an assault (''putative,'' or ''self-inflicted,'' wounds) and then are almost always superficial in character, the lips of the wound, however, being kept apart sometimes, during the process of healing, in order that a large and showy cicatrix may result. Almost invariably, in such instances, the factitious wound has been resorted to in order to give objective evidence to a claim of traumatic amblyopia or amaurosis. The superficial character of the scar, together with the various tests for simulated amblyopia and amaurosis, as above set down, will almost invariably reveal the fraudulent character of the claim.

Ecchymosis, being a very common accompaniment of contused wounds of the eye, affords at times important evidence in connection with fraudulent claims. One should ever bear in mind that an ecchymosis of these parts is at first violet, blue-black, or livid red in color: in a day or two, green, then yellow, then lemon-yellow, finally whitish-yellow and normal. One should also remember that, in ecchymosis of

the upper lid, the darkest portion of the discoloration is always, after the lapse of a few hours, at the lower lid-margin,[1] the changes in color above noted showing earliest at the upper boundary of the discolored area. It is, of course, impossible to determine the precise age of an ecchymosis from its color; yet, in many instances, the hue of the part affords irrefragable evidence of a fraudulent claim. Thus, for example, if a claimant with an ecchymosis in the livid, or blue-black, stage, especially if the darkest part (in the upper lid) had not yet settled down to the lower lid margin, should allege that this discoloration had been produced a week or thereabouts before, we should know to a certainty that he was "mistaken."

Emphysema, with crepitation, of the lids and orbit can be produced by injecting air into the loose areolar tissue of these parts, and a simple tumefaction without crepitation, lasting for several days, can be produced (as every ophthalmo-surgical expert knows) by the hypodermic injection of solutions of cocain and other substances—and, in some instances, even of plain water.

Ulcers in the skin of the eyelids can easily be manufactured by means of the various irritants, corrosives, and vesicants. The most commonly employed are: chewed tobacco, bruised garlic, nitric acid, corrosive sublimate, and quicklime. I have even been informed that a miner who was lightly burned in a mine explosion actually burned the lids of both eyes, as well as other portions of his face, by means of a candle flame, applied by his own hand, in order to increase the extent and severity of the ulcers that followed, and thus the amount of probable compensation to be received by him.[2]

The injuries and discolorations produced by the different sorts of acids and alkalies are worth recalling in connection with the fraudulent or mistaken attribution of injuries. Thus, sulphuric acid turns the skin brown; nitric acid, yellow; while hydrochloric acid either does

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[1] A phenomenon due to the fact that the extravasated blood "settles" down through the loose interspaces of the palpebral areolar tissue till it reaches the lower lid margin. About the body generally, the darkest portion of an ecchymosis corresponds pretty closely to "the point of greatest violence"—*i. e.*, of greatest crushing, or contusing, force—a state of affairs which continues as long as the ecchymosis remains visible.

The extravasated blood not infrequently seeps beneath the skin covering the dorsum of the nose, and so on into the loose areolar interspaces of the lids of the opposite eye (the falsely denominated "sympathetic" ecchymosis). The skin of the nose being very thick and opaque, the ecchymosis is, in that part, invisible, and hence it appears that an independent ecchymosis of the opposite eye has taken place, perhaps as the result of a fracture. This phenomenon of an apparently independent ecchymosis in the opposite eye, is so common, after an enucleation of the eyeball, as to be familiar to all ophthalmic surgeons.

[2] It may not be uninteresting to note that the artificial production of ulcers is probably "the earliest, as it has been the most extensively excited disease." Gavin, ***Feigned Diseases***, London, 1843, p. 332.

not stain it at all or turns it very faintly yellowish or yellowish-brownish. Acids (especially "vitriol," or sulphuric acid) were in former days frequently (they are even yet occasionally) "thrown" by women into the faces of their rivals, with the almost invariable results that the skin of the eyelids and eyebrows was cauterized, and a suit for damages or criminal prosecution (not infrequently both) was now and then the result. Acids, too, as already stated, are used for the artificial production of ulcers and cicatrices, on which conditions a claim for damages can be based. Alkalies discolor the skin at first white; later, red or dark-brown.

To distinguish the so-called "burns" produced by such escharotics from burns produced by heated substances—a distinction sometimes necessary—the following points are useful:

(a) If the injury be recent, a chemical test can be made, and the presence of sulphuric, hydrochloric, or nitric acid, or other escharotic liquid on the skin can easily be determined. If any of the escharotic has been spilled upon the clothing, or other surrounding objects, the chemical test is still more applicable.

(b) Scorching of hairs in the neighborhood of the injury, points to a heated substance of some sort as the almost certain origin thereof, for escharotics do not affect the hairs of the nearby parts.

(c) Blisters, which are almost always present after injuries produced by heated bodies, are never produced by the action of escharotics.

(d) After the action of an escharotic there is never capillary congestion (erythema) of the skin surrounding the injured area. This phenomenon occurs invariably after burns by heated substances, if of more than the first or second degree, unless the injuries are followed so promptly by the death of the injured person that this symptom of reaction does not have time to appear.

(e) Burns by heated solids can generally be distinguished from burns by heated liquids, as well as from the results of escharotics, whether liquid or solid, by the fact that the eschar which is produced by an escharotic, or by a heated liquid, is soft and moist and yellowish, instead of hard and dry and dark, as after an injury produced by a heated solid.

A very important subject in connection with the fraudulent attribution of injuries, is that of scars in the skin of the lids, especially with relation to their age, for, sometimes, the false attributor alleges of an ancient cicatrix that it is recent, or, on the other hand, of a recent cicatrix, that it is old. Such people also not infrequently cause cicatrices to be artificially removed (so far at least as this is possible)

and, on the other hand, declare that scars which formerly existed have spontaneously disappeared.

At the very beginning it should be thoroughly understood that, in the skin of the eyelids as in other portions of the body, very superficial burns or wounds, involving only the epidermis or the superficial part of the derma, produce no scar at all or else a scar that promptly disappears completely. We may also say—for the sake of completeness, since the matter is otherwise unimportant—that a punctured wound produced by an instrument of the nature of an extremely fine needle and consisting merely in the separation of the anatomical elements of the skin and underlying tissues without the production of a bloody tract, produces absolutely no cicatrix whatever of any sort or kind. In the case of a punctured wound accompanied by the production of a bloody tract (however slight the hemorrhage may be) there results invariably a scar. This scar, at first, is merely a reddish point. Later, it becomes of a dark brownish color, and increases a trifle in area (as any one has seen in the case of the punctate scars produced by sutures in the skin of the lid). Still later, the scar begins to bleach, and, at the same time, to contract, till, finally, the color is a pearly-white and the area very small indeed. May such a scar disappear entirely? In my opinion it may, practically at least, whatever it may do theoretically. Linear wounds and wounds of square extent, result in cicatrices, invariably. Generally speaking, too, such scars are indelible unless tampered with. However, scars in the skin of the eyelids disappear oftener and more completely than in almost any other portion of the body. Operations, furthermore, may be resorted to which change the appearance of all such scars, or even (when the cicatrices are not too extensive or too deep) remove them to such a degree that, at least for all practical purposes, the condition of the skin is exactly the same as though the scar had never come into existence. If the scar is too deep, the skin can never be restored quite to its former condition of free extensibility (permitting, in fact, of far withdrawal from the underlying parts) and, if too extensive, the skin will, after the operation, be shortened and tight-looking, devoid, in fact, of the folds and wrinkles displayed by the skin of the corresponding lid of the other eye. Sometimes, however, by an operation on this other eye, a symmetrical and therefore very deceptive condition indeed can be produced. Extremely accurate examination is necessary in all such cases, and a magnifying glass is often helpful.

Just at what age of the wound the different color-changes occur in a scar cannot be determined precisely (however devoutly such a consummation might be wished) even for a particular case. In general,

however, cicatrization is complete (i. e., the scar has completely *formed*) in about four days after a simple, linear, and non-infected incised wound, whose lips have been appropriately approximated Wounds of superficial area heal more slowly than incised wounds and wounds in aged persons or diseased subjects much more leisurely than in young and healthy. The pink, or reddish, *young* cicatrix turns to the older brownish variety in about eight weeks, or perhaps a little more. In from two to three months additional, the cicatrix has bleached and taken on the well-known appearance of an ancient cicatrix—an appearance which, under normal circumstances, is just about permanent.

All cicatrices, however, whatever their original shape, in the eyelids as elsewhere about the body, tend to become more and more linear in form. Then, too, ancient cicatrices, in the skin of the eyelids as in the body generally, get a trifle smaller in area and a little thicker, as they increase in age, excepting in children only, in whom they actually enlarge in area as well as in thickness. When, however, children reach adult life, their ancient cicatrices begin to contract.

Scars are much more apparent in brunettes than in blonds, and they are also said to stand out much more plainly in negroes than in Caucasians, by reason of the fact (as alleged) that a cicatrix never acquires a *rete mucosum* even in the negro and hence is forever devoid of coloring matter even in the African race. In my personal experience, however, the statement has not held good. I have seen in negroes numerous scars that were very deeply pigmented, and, in the eyelids, many that required the most careful observation for their detection.

Scars otherwise imperceptible may often be brought out plainly (in the white race) by smart friction of the lids, a procedure which reddens the skin and makes the white scar plainer by the contrast. A lens is always useful.

Burns produced by explosions of gun-powder sometimes have to be distinguished from those produced by fire-damp explosions, which occur so frequently in mines. The necessity is all the greater from the fact that, in each of these kinds of burns, the hairs of nearby (possibly also distant) parts are invariably scorched: hence no means of distinction is afforded by the presence or absence of scorched hairs. However, the distinction is very easily made by the difference in the tattoo marks in the skin which each of these forms of explosion produces. The distinction is made in three ways: 1.—The coal tattoo is blacker, and less violet, in color, than the dotting made by gun-powder. 2.—The coal-dust spots vary greatly in size, while the dots from gun-powder are almost absolutely uniform. 3.—Particles of gun-powder,

or of coal, can be picked out of the skin, and their nature determined chemically.

2.—*Injuries of the conjunctiva and cornea.*—In *traumatic conjunctivitis* the question is nearly always as to whether or not the inflammation of the conjunctiva is traumatic or non-traumatic in origin. How, then, can a distinction be established between a traumatic conjunctivitis and one not traumatic? If the conjunctival inflammation be alleged to have been produced by a powder or a fire-damp explosion, there will nearly always exist in the conjunctiva (also, perhaps, in the skin of the lids) the same, or a very similar, bluish or blackish tattoo which is produced in the skin by such explosions. There will also exist the indications of a burn, namely, shortening, thickening, wrinkling or puckering, and opacification of the conjunctiva, as well as adhesions (symblepharon) between the eyeball and the lids. Burns by acids and alkalies leave also conjunctival cicatrices, together with, almost invariably, the characteristic stains upon the skin. Any considerable quantity of nitric or sulphuric acid in the eye causes deep sloughing, which means, of course, perforation of the eyeball.

Conjunctivitis, alleged to be due to trauma, is occasionally manufactured by the intentional introduction into the conjunctival *cul de sac,* of tobacco juice, particles of sand, bits of lime, drops of lemon juice, and solutions of bluestone or corrosive sublimate. Foreign bodies of considerable size and irritating properties have been discovered, neatly bestowed within the folds of the upper conjunctival commissure, to the presence of which was due a spurious conjunctivitis; it is therefore desirable, in all suspicious cases of traumatic conjunctivitis, to examine carefully the recesses of these folds.

Traumatic pterygium occasionally occurs as a result of injury to the conjunctiva and cornea, and, now and then, a claimant for damages alleges that a pterygium of the ordinary spontaneous[1] variety was produced by an accident for which he seeks to hold some company or individual responsible. The distinguishing points, however, between these two varieties of pterygia render impossible the acquiescence by any honest expert in such a mistaken, or fraudulent, explanation of the origin of the growth. The central point of distinction lies in the fact that a pterygium of traumatic origin (customarily so designated) does not possess a pterygial canal, or epithelium-lined passage which lies between the growth and the eye at the sclero-corneal junction.

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[1] All the so-called non-traumatic, or spontaneous, pterygia, however, probably originate in slight, repeated traumata. See on this head an article by the present writer, entitled "Pterygium," in the *Ophthalmic Record,* Vol. 14, No. 10, Oct., 1905, p. 465.

Further, a pterygium of traumatic origin is often adherent more or less extensively to the eyelid, thus giving very plain evidence as to the nature of the origin of the growth. Still further, a traumatic pterygium is less transparent, thicker, and also less freely movable on the sclera. Then again, a false or traumatic pterygium is seldom situated (as is that of the ordinary variety) symmetrically astride the horizontal meridian of the eyeball—in fact not only is it often more above or more below this line, but it is not infrequently situated wholly above or wholly below the cornea. Finally, a traumatic pterygium is never progressive, while the ordinary, or true, pterygium may or may not be so.

3. *Injuries of the iris.*—The salient points to be remembered in connection with the fraudulent or mistaken attribution of injuries to the iris relate to the fact that many anomalies of the iris, which seem to the inexperienced observer to be traumatic, are really congenital. These matters were considered somewhat fully in a former division of this article, but here it may be well to remind ourselves of the following extremely important characteristics of certain congenital anomalies.

a. The threads of a persistent pupillary membrane (often mistaken for posterior synechiæ) do not arise (as do the synechiæ) from the margin of the iris or its posterior surface, but from a point on the anterior surface of the iris, a trifle removed from the pupillary margin. Also, under atropin, these threads prove very elastic.

b. Congenital coloboma of the iris can be distinguished from traumatic coloboma and from retroversion and retroflexion by the fact that, in a congenital coloboma, the sphincter iridis continues into and around the gap unbrokenly. Further, it is almost (though not quite) always situated below, and is frequently associated with coloboma of the choroid, corpus ciliare, and lens.

c. Heterophthalmos, corectopia, and polycoria, are liable to be mistaken by the ignorant for the results of traumatism, but a person accustomed to examining injured eyes could hardly be imposed upon to that extent by such plainly congenital anomalies.

4. *Injuries of the lens.*—A claimant now and then attributes to an accident or an assault a condition of the crystalline lens which is really congenital or the result of some spontaneous disease.[1] Thus, a congenital, or a senile, or a diabetic cataract may falsely be attributed to

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[1] It would seem, according to Woodward, that traumatic cataracts had been known to be ''self-inflicted,'' or ''putative.'' Thus that writer in Witthaus and Becker's *Medical Jurisprudence, Forensic Medicine, and Toxicology*, 1896, Vol. III, p. 28: ''Cataract has been intentionally produced by thrusting a needle or a knife-blade through the cornea into the crystalline lens.''

a cause for which some corporation or individual could be held responsible in damages. A traumatic cataract, however, is generally produced by the action of a penetrating instrument (this, sometimes, is a foreign body which remains) and, in such a case, the tract whereby the inflicting instrument made its way through the ocular tissues to its point of contact with the lens, is easily enough determined. In such a case there can be no doubt as to the origin of the cataract. Even if the instrument were very small, for instance a delicate needle, no doubt could exist if lenticular matters were being extruded into the aqueous through a rent in the capsule. Sometimes, however, a mere contusion, or concussion, of the eye suffices to originate a cataract, and then the distinction between such a lenticular turbidity and a congenital or senile cataract may become a harder matter. Even in such a case, however, the distinction is generally sufficiently obvious on account of the extremely regular and symmetrical appearance of congenital and senile opacities, while the lens turbidity produced by traumatism of any sort is nearly always irregular. Then, in addition, in congenital cataract, the eye as a whole is apt to be very badly developed. The claimant's history will almost always, unless he be an infant, conclusively settle the matter.

Luxation and subluxation of the lens may be congenital or the result of disease, as well as produced by trauma. When occurring as the result of disease, the pathological condition consists of softening and wasting away of the zonula, which, in its turn, is occasioned by high-grade myopia and choroiditis. Then, too, a spontaneous variety of dislocation occurs in hypermature cataracts as a result of overstretching of the zonula. The various concomitant conditions, of course, point out the nature of these spontaneous dislocations, while, where the lens is congenitally out of place, the dislocation is almost always upward, the lens is small in size, the eyeball as a whole is apt to be poorly developed, and, finally, there exists a life-long history of inferior vision.

5. *Injuries affecting still deeper portions of the eye.*—Injuries of the vitreous, the sclera, the choroid, the retina and the optic nerve, are also now and then attributed to suppositious causes, but, in these cases, the ophthalmic expert has little that is special to guide him; he can merely employ his knowledge of ocular pathology in general.

Exaggeration of ocular injuries and diseases. Tests for exaggeration.—Exaggeration of the effects upon the sight of various actually existing injuries and diseases (whether or not such injuries and diseases are attributed to untrue causes) can generally be detected by noting the nature and situation of the various pathological lesions,

and also by means of the tests for simulation (laid down some distance *supra*) since the tests for simulation are useful in exaggeration. Of especial importance among these tests is that of Alfred Graefe, because thereby the examiner may, unknown to the subject of the test, determine accurately the visual acuity of each eye. It should be remembered that an actually existing amblyopia may be so exaggerated as to seem an amaurosis, and also that even an actual amaurosis may be exaggerated by the contention that it has been in existence for a longer time than is really the case. In the latter state of affairs, if the amaurosis be alleged to be of very long standing, the examiner will, of course, be careful to note whether, as yet, the eyes have taken on the ''staring, fixed, unmeaning'' look of eyes that are truly blind, as well as whether the applicant himself has acquired the short steps, the upturned countenance, and the generally ''listening'' expression.

Dissimulation of ocular defects and diseases. This form of falsification is not very common in America. In Europe, however, especially since the passage of the various ''Workmen's Compensation Laws'' (which render employers liable for injuries to their workmen, irrespective of all such technical matters as assumption of risk, contributory negligence, etc., etc.) the number of dissimulators has increased enormously. This consequence arises from the fact that, when an employer is obliged, in effect, to insure his workmen, he desires to know to a certainty before he grants employment to any given man, that the applicant is possessed of sufficient visual power to keep from being hurt. He stands, in a word, where subject to such laws, in much the same position as an accident insurance company or a life insurance company. For this reason, it is said, the Workmen's Compensation Laws, beneficent as they are in many respects, have entailed much hardship on workmen already defective. Defective workmen, in fact, find great difficulty in securing employment where such laws as those in question exist. And even in America, dissimulation is practised now and then, not only by those attempting improperly to effect accident or life insurance, but also by persons endeavoring to secure employment with railway or steamship lines, to be admitted to the army or the navy, and even to contract advantageous marriages.

Our chief solicitude should be, when testing the eyes of those who may be dissimulators, not to rest content with a mere determination of the central visual acuity. Thus, a person's central vision may very well be in each eye 20/15, or above normal, and yet his peripheral vision be very poor indeed. Again, with excellent central sight, he might be harboring a foreign body in the vitreous, or be suffering from chorio-retinitis, peripheral lenticular opacity, or eccentric ulcer of the cornea. Further, he might be afflicted with mydriasis, with or

without paralysis of the accommodation, or, if tabetic, with Argyll Robertson pupils.[1]

Visual economics.[2] An expert witness is often required to furnish the jury certain facts and principles in accordance with which that body may be able to determine the amount of damages which ought to be awarded, or, as the law expresses the matter, "to assess the damages." We have already seen that, in assessing damages in a personal injury case, a jury may allow for matters such as: (1) necessary and reasonable expenses—hospital fees, for example, and nurses' and doctors' bills; (2) loss of time; (3) pain and suffering; (4) disfigurement; (5) reduction of the earning capacity. This latter is often, perhaps generally, the most important item in the list. Now it so happens that, with respect to injuries of the body generally, either the actual reduction in the earning capacity must merely be guessed at in the most haphazard fashion, or, really, cannot be estimated at all. In the case of the eye, however, the matter is different. When an eye is injured, an experienced oculist can (as a rule to which there are scarcely any exceptions) determine the quantum of injury (i. e., the reduction of earning capacity) with well-nigh mathematical accuracy. Nevertheless, owing to the fact that a proper formula had not yet been worked out, the accurate estimation of the loss of earning power was, even in a case of ocular injury, by no means possible until very recent years. Now, however, thanks to the labors of Zehender,[3] Groenouw,[3] Heddæus,[3] Jatzow, Josten, Hansel, and, most of all, to Magnus,[3] of Breslau and Würdemann,[3] of Seattle, the subject of "Visual economics" has been developed into a useful and, everything considered, extremely accurate science.[4]

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[1] Finally, he might be afflicted with an excellent memory, in support of which paradox I cite the case of a gentleman who, a number of years ago, desired that I permit him to copy the four smallest lines, together with the largest, of each of my Snellen cards. He intended, he said, "to take an examination for a railroad," and, being "short" four lines, or thereabouts, to commit the top line and the bottom four to memory. Thus fortified, he could read the bottom four lines of any card, out of his memory, whenever he saw the top one. The company-doctor and I, he said, had just the same identical cards.

[2] For an entirely different view of this subject, see, in this *Encyclopedia,* "**Visual economics,**" a very thorough article by Dr. E. E. Holt.

[3] These men have proposed formulas; the others mentioned have proposed no formulas, but have rendered yeoman service in connection with "Visual economics" nevertheless.

[4] The classical work on the subject is "*Visual Economics,*" by Magnus and Würdemann, Seattle, Wash., 1902. So exhaustive and so accurate, in fact, is this little book of 115 pages, that but little apparently remained for subsequent writers on the topic of "Visual Economics" to do, but to amplify or to abridge that epoch-making book. Dr. E. E. Holt, however, has added to the subject much that is novel and interesting. The reader who desires to study the subject thoroughly, is, therefore, referred to the book in question as well as to the major article of Dr. Holt: all that is here attempted is an abstract of the Magnus-Würdemann volume. Moreover, whenever possible within the limits of this article, I permit the authors of that treatise to speak in their own words.

Passing by the formulas of Zehender, Groenouw, and Heddæus, which have been supplanted entirely by that of Magnus and Würdemann, I will state the latter formula at once, and then proceed to an explanation of the means whereby that formula is ophthalmologically and mathematically deduced.

The formula itself.—The complete formula, then, for the ocular earning ability, is as follows:

$$E = C\ (\text{max.})\ \sqrt{\bar{P}}\ \sqrt[4]{\bar{M}}\sqrt{\frac{C_1 + C_2}{2}\ \sqrt{\bar{P}}\ \sqrt[4]{\bar{M}}}.$$

Now, while this formula, at first sight, appears a little complicated, it is really rather simple, as will readily appear from the forthcoming explication. Moreover, as Magnus and Würdemann state,[1] "If we try to simplify the complicated relations they could only be forced, and an arbitrary speculation substituted for its [the formula's] own composite character." Then, too, this formula is not by any means supposed to be presentable to a jury, but only its results; as, for instance, that the earning power of the plaintiff in the particular case at bar has been reduced, in consequence of the injury of which he complains, by 42 per cent. Exactly what amount this percentage of reduction would be equivalent to, expressed in dollars and cents, would be for the jury to compute, and, indeed, they ought to be equal to so very simple an arithmetical task.

The method whereby the formula is obtained.—The formula in question is based upon the supposition (which surely is not refutable) that "injuries affecting the vision have a direct detrimental effect upon the earning capacity." From this very simple proposition there follows another, which is almost equally self-evident, namely, that "the earning ability . . . is practically synonymous with the visual earning ability." True it is that, in certain occupations, "such as banking" and "some mercantile pursuits and professions where knowledge may be assimilated through the eyes of others . . . some specially well placed and talented individuals may continue to be economic factors;" but these are great exceptions, and, in the vast majority of cases, the blind are "incapable of earning anything" and are "a charge upon their families and upon the community."

Now, it would seem, at first, to follow, from the second of these propositions, that the "visual earning ability" was exactly synonymous with "the visual working ability," i. e., that any reduction in the visual acuity, or other functional ability of the eyes, would necessarily result

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[1] Magnus and Würdemann, *Visual Economics*, p. 53.

in a loss of the ability to follow a gainful occupation. This, however, is not at all the case, as will appear hereafter. Various ocular incapacities can, in fact, exist, without the slightest loss of earning power being occasioned thereby. However, more of this hereafter.

The factors which constitute the earning ability.—In a normal person the complete earning ability "is a composite quantity resulting from three factors:

"(1) The unimpaired functional power of the bodily organs.

"(2) The technical knowledge which is necessary for the carrying on of the vocation.

"(3) The ability of the individual to compete in the labor market."

The most important of these three factors is the normal functioning power (devoid of sight, a person is, as a rule, altogether dependent upon the bounty of others); a very close second in the matter of importance, at least in very many occupations, is the preparatory education, or technical knowledge; while, far in the rear, we find the ability to compete.

In making out the formula which is to express the equivalents and make up of the normal earning power, we designate that power itself by E. Then we express the three elements of which that composite quantity is made up, as follows: the functional ability, by F; the technical knowledge, by V; and the ability to compete, by K. The formula for the full normal earning ability is, then, this:

$$E = F\ V\sqrt[x]{K}$$

K, it is of course necessary to notice, is taken as a root, not as a full, value. The reason for this is stated by Magnus and Würdemann thus: "In this formula we put the two quantities, F and V, in their full value and accept K as a root value. There would be nothing changed in the total value of the formula itself because as the root of 1 is always 1, and we regard F, V, and K as 1, it is immaterial for the formula itself if we take one of the three quantities as a root or not, but this proposition immediately changes when the part introduced as a root grows smaller than I, as happens in each ocular injury, because the root of each genuine fraction is always greater than the fraction itself. Thus the influence of K, after being introduced as a root value, if it has fallen off by an injury to $\frac{K}{Z}$ cannot be any more $\frac{K}{Z}$ but must be greater, for instance, $\frac{2K}{Z}$ Therefore, the damage to the total value of the formula will be smaller if we take K

as a root value. By the total elimination of K the earning ability will not be diminished, but it will be by a smaller damage, according to the influence the damage of K shall exercise upon the value of the total formula. We will have to choose the exponent of the root as smaller or greater, according to its rating. The value of a root of a genuine fraction is much greater if its exponent is small. Therefore, if we wish to lower it considerably, we take a small, if we wish to affect it less, a greater exponent for K. While the ability to compete, K, is comparatively very little impaired through minor ocular injuries, it is very much so through the loss of one eye; we suit these conditions by choosing a greater exponent of the root in slight injuries, but a smaller exponent for serious ones. We will adopt for the slight injuries K as the 10th root and for serious ones according to the demands of the profession, the 7th root or the 5th root. . . . An exact calculation of such a changeable quantity so dependent upon the individual cannot be made. The calculation of the competing ability cannot be waived entirely, . . . but should include all factors that are relative; as we will show further on, the peculiarities of the individual case may always be considered.

"When we express the earning ability through the three factors, F, V and K, we present E, not as a sum, but as the product of these quantities, as multiplied thusly: $E = F\ V\ \sqrt[x]{K}$, in which the exponent x changes with the degree of the functional damage. E must always be regarded as a product and not as a sum, to meet all possibilities occurring in practice. If we add F, V and K, the formula would give wrong practical results, as we see in the following example: Supposing both eyes were lost in an accident, the quantity F of our formula would be o. If we had connected F, V and K with the +, and added, even if K would have become o, $V + \sqrt{K}$, which is the remainder of the earning ability, would have been left. This would be entirely wrong, because a laborer who has lost his functional ability, especially the sense of sight, should be regarded in an optical way as entirely unable to earn. Taking the same example and using our formula with F=o, E immediately becomes o, because each product is always o if one of the factors is o. If we would leave V out of our formula, E of course =o, and actual practice confirms this, because even the most simple hand work requires a certain amount of preparatory education. Finally, if we drop the third factor, the 10th root of K, the normal earning ability according to our formula becomes o, which is likewise shown by practical experience, because, even though an individual is in good health and by reason of preparatory education has the skill to work, if his work is not needed,

his economic value is *nil*. He may possess the power of working, as the factors F and V are present, but he only has earning ability when he can dispose of the work in the economic market. Therefore, if from our formula ($E = F\ V\ \sqrt[x]{K}$) we take away the factor $\sqrt[x]{K}$ (the ability of the individual to dispose of his work), the remainder, which is the formula for the working ability (A), would be $A = F\ V$.

"The 'working ability' is not synonymous with 'earning ability,' although some authors would have it so, for instance, Becker (5, p. 9): The words 'working ability' and 'earning ability may be regarded identical in meaning, because in each worker the latter depends upon the former.' Even if this be so, the two conceptions are not the same, and such a rendition obscures the conception of the earning ability, our definition of which should be clearly understood.

"The calculation of injury to the earning ability proposed by us starts from the formula for the *full earning ability:* $E = F\ V\ \sqrt{K}$."

The formula may be simplified by the absolute omission of the factor V. Important as is this factor (the preparatory or technical education) it will never itself be damaged directly by any ocular injury. "Certainly the visual function may be diminished to such an extent that the realization of the technical knowledge becomes limited, but this injury to the earning ability in such a case does not rest upon a diminution of the knowledge and the capacity, but limitation of their use. We calculate the extent of such limitation, according to our method, directly by the factor F, i. e., from the performance of the visual act, which is the essential factor in the full earning ability, damage to which is synonymous with damage to the total. Calculating F we have already used V. For simplicity's sake it would be better to omit V entirely. The *working formula* for the earning ability then would be: $E = F\ \sqrt[x]{K}$."

As, however, we look at this simplified equation, the thought is borne upon us that, before we can apply this formula for the estimation of visual economic damage, we shall have to consider the various elements of which F (the functionating ability of the eye) is composed—for F is, undoubtedly, a composite, and not a simple, quantity. F, in fact, is composed of:

1. The central acuity.
2. The visual field.
3. Light and color senses.
4. The adaptive faculty.
5. Muscular movements.
6. The cerebral processes.

Again, however, we may simplify: undoubtedly not all of these factors are necessary to be considered. The cerebral processes, for example, may be left out, because in cases of injury to the brain sufficiently severe to affect the cerebral ocular centers, the damage is by no means limited to these centers and the neurologist, instead of the oculist, is called in. The sense for light and color, furthermore, and that of adaption, are not to be considered separately, because an injury limited to these functions is unknown. Such an injury is always an implication in, or complication of, an injury to the visual acuity or else to the visual field. When, therefore, we allow for damage to the visual acuity or the visual field, we include the implicated injuries to the light and color sense and to the power of adaption. Thus the six constituents of F reduce themselves, in practice, to only three. These three constituents stand to one another in the relation of factors of a product; for, in the following of an occupation, not a single one of these factors could be left out. Devoid of any single one of them, the possessor of the damaged eyes would have an earning power of practically nothing whatever. The elements, therefore, should be regarded as factors; not as the elements of a sum; in other words, as $o \times 1 \times 1$, and not as $o + 1 + 1$.

Perhaps the assertion that the leaving out, or rather the destruction of any of the three important elements of F, would result in what is practically complete annihilation of the earning power, should receive a modicum of consideration. Let us first regard the element of central acuity, which, for brevity, we may represent by the letter C. Now, a person who has, in both eyes, lost C—i. e., is suffering from a large central scotoma—sees absolutely nothing whatever at which he directly looks. He can only see a given object by looking somewhat away from it, and, under such circumstances, an artisan is totally unable to work. Perhaps a person afflicted with a large central scotoma might be able to earn a trifle as a messenger. Practically, however, he is totally blind. If, again, a person, though retaining C, has yet been deprived of all peripheric vision—which we shall represent by P—he also could not work at any trade, "as is readily seen in cases of double-sided hemianopsia." Still further, if a working man were to suffer complete paralysis of all the extrinsic muscles of both of his eyes—in other words should lose what we shall represent by M—he, also, would be totally disabled. The only visual act which he could execute would be to "stare into vacancy," and see double. He would also have no power to estimate distances or the size of objects. Even though he should close or cover one eye, and thus pre-

vent the disconcerting diplopia, the other eye would be immovable and therefore useless in an economic sense.

Returning to our formula, before we substitute for F its factors, C and P and M, we must consider certain very significant matters which are connected with these factors. In the first place, as to the relative importance of these factors, C (the central visual acuity) is the most important of all. Whatever reduces C below the lowest limits demanded by the kind of trade, or calling, in question, of course produces for that work a total disability. P (peripheric vision) clearly comes next to C in importance, while, finally, there comes M. With regard to this factor M, furthermore, we have to consider the very important fact that the effect of a paresis or paralysis of a single, or of several, ocular muscles, is very different indeed, according as we have to do with monocular or with binocular vision. Monocular vision is, in fact, but little affected even by the complete paralysis of a single extrinsic muscle. Such an affection merely diminishes the motility of the eyeball. In binocular vision, however, the element of diplopia enters in—a fact "of the greatest importance, as it excludes, temporarily, at least, retention of working binocular vision." In the construction of a formula, therefore, we treat the factor M in a different manner, according as we have in view binocular, or monocular, vision. "In the formula for binocular vision we take the muscular movements of each eye as the product of different factors, each of which corresponds to the activity of a particular muscle. Now, if we mark the muscles of one eye with $(m^1m^2m^3m^4m^5m^6)$ and those of the other $(m'^1m'^2m'^3m'^4m'^5m'^6)$ etc., we would represent the whole muscular activity as $(m_1m_2m_3m_4m_5m_6)$ $(m'_1m'_2m'_3m'_4m'_5m'_6)$. In this conception the whole product would be o, by losing one single muscular motion, and therefore the binocular act would be negative. In monocular vision the muscular activity should be conceived as the sum of the single performances, because, by losing one of them only, an ocular detriment has been created and not total earning disability, thus $m_1+m_2+m_3+m_4+m_5+m_6$."

Still further, M and P should both be added to the formula as root, not full, values, precisely as was done in the case of K (afterwards omitted) and for exactly the same reason—i. e., the damage to the total value of the formula will be smaller (which accords with the less importance of M and P as compared with C).

In the words of Magnus and Würdemann again: ". . . the value of the root of a proper fraction increases with the amount of its exponent, thus, if we introduce M with a greater exponent of the root than P, in the case of damage to M, it will exercise less influence

upon the total value of the formula. We believe that we may place the relative value of the visual field and the muscular movements by choosing as exponent of the root in the former 2, and in the latter 4. Of course, these are arbitrarily chosen, as it is an undisputed fact that the central visual acuity, peripheric vision and the muscular movements have different meanings in the act of vision, the proportional valuation of which cannot be put into figures from observation nor from measurement, it is certainly allowable for the mathematician or the physician to estimate the amounts of these exponents differently, but the formula itself will not be changed."

The formula, then, for binocular vision is as follows:

$$S^2 = C\sqrt{P}\sqrt[4]{(m_1m_2m_3m_4m_5m_6)\ (m'_1m'_2m'_3m'_4m'_5m'_6)}$$

In this formula, C is the central visual acuity in the better eye.

The formula for monocular vision, however, is this:

$$S_1 = C\sqrt{\tfrac{5}{6}P}\sqrt[4]{\tfrac{2}{3}(m_1 + m_2 + m_3 + m_4 + m_5 + m_6)}.$$

The fraction $\frac{5}{6}$, standing before P, denotes the fact that the monocular field of vision is $\frac{5}{6}$ as extensive as the binocular. The value of the muscular function is $\frac{1}{3}$ less in monocular than in binocular vision; hence it is estimated at $\frac{2}{3}$ the binocular value.

Economic limitations of C.—The economic limitations of the central visual acuity are not identical with the scientific limitations of the same faculty. This, at first, may sound a trifle startling, yet, on due consideration, we find that the statement is true. Take for instance the downward limitation. Science calls a person blind only when the acuity has entirely disappeared. Economically, however, an individual is blind when the acuity has become so low that the earning power is *nil*. Take, again, the upward limitation. Scientifically, the acuity equals a hundred per cent. only in case the acuity is approximately 20/20. Economically, however, the acuity may equal a hundred per cent. (i. e., permit of plenary earning capacity) although it is only 20/30, 20/40, or even 20/50 or less. Much depends upon the nature of the occupation, of course, some occupations requiring a high, others only a low, degree of central visual acuity in order to the possession of plenary earning power. However, there is hardly any occupation which demands for its full and adequate exercise the possession of scientifically perfect central visual acuity. Generally speaking, we may say that an acuity of 1/20 is the extreme downward limit of useful acuity in any occupation, and 20/30 the extreme upward requirement. Further, the maximum and minimum limits do not have

to exist in both eyes. If one eye possesses a minimum, the other may possess less (even, in fact, as little as absolute zero) and still the acuity of the eyes as a visual whole is up to the minimum requirement. Likewise, if one of the eyes possesses a maximum acuity, the other may possess less (even, in fact, as little as absolute zero) and still the acuity of the eyes as a visual whole is up to the maximum requirement. Magnus and Würdemann divide the different occupations into two groups—those requiring high, and those requiring low, degrees of visual acuity, and specify a rather large number of trades and professions belonging to each group. To each of the groups they assign a maximum and a minimum C. Much as we deplore the inability, we cannot reproduce such matters in this article, on account of lack of space.

The economic limitations of P.—As in the case of C, so also in the case of P, the scientific and the economic standards are not at all the same. In the vast majority of callings, monocular limitations of the field do not impair the earning power. Magnus and Würdemann, following Schroeter, divide the binocular field into three zones of 30° each. The first zone reaches from the outermost periphery to 60°; the second, from 60 to 30°, the third from 30° to the fixation-point. These three zones are not of equal value in certain respects, yet, as what zone 3, for instance, lacks in functional ability, it makes up for by its greater extent, these three zones of P are accorded equal value. By this conception, then, the entire binocular field of vision (exclusive, of course, of what we have represented heretofore by C) consists of three factors of equal value. Thus a loss of one eye entails a loss of $\frac{1}{6}$ the binocular field (no more than that, because of the overlapping of the single fields in the binocular) and a homonymous hemianopsia entails a loss of $\frac{3}{6} = \frac{1}{2}$.

Economic limitations of M.—The economic loss (in a person possessed of binocular vision) arising from the impairment of a single ocular muscle is very great indeed, because, diplopia appearing in consequence of the injury, one eye must necessarily be excluded from the visual act, in order that useful vision may be exercised at all. The loss, therefore, economically, is exactly the same as that which results from the destruction of one eye. In case, however, the subject was possessed before the accident of monocular vision only, then a smaller degree of economic loss should be imputed to the impairment of a muscle in the seeing eye. In fact, in such a case, the economic loss is approximately $\frac{1}{6}$. However, the six extrinsic muscles do not all possess exactly the same value, at least under any and all circumstances. Thus, for a miner or a compositor, the rectus superior is especially

important; for a sailor, the rectus externus; for a bookkeeper, a jeweler, an oculist, etc., the rectus internus. For people generally, the rectus internus possesses the most value.[1]

Special consideration of the ability to compete (*K*).—When a person's eyes are injured, the damage which has been done to him is frequently two-fold: first, there is the actual impairment of the working ability of the eyes; second, there is a diminution in the injured person's chances of getting or of keeping a job. "Practical experience," for example, "shows that a one-eyed person not only has more difficulty in finding employment,[2] but that in some factories his visual disorder makes it difficult for him to retain his employment. . . . The injured person, therefore, has a right to claim not alone a compensation for the impairment of his capacity for work, but also the difficulty which he encounters in making the most of this capacity." Thus Magnus and Würdemann. The courts, moreover, have begun to sustain this view. Thus the highest tribunal in England, the House of Lords, has, very recently, sustained it. "A workman who had lost the sight of one eye from an accident was subsequently able to obtain work because the defect in his sight had not been observed. As the result, however, of a second accident the blind eye had to be removed and he was thus prevented by the obviousness of the defect from obtaining work. By a majority of two to one the Court [of Appeals] held that the words 'incapacity for work' in the Workmen's Compensation Act must be interpreted strictly, and that the man was not entitled to compensation from his employer for the second accident, because his incapacity for *performing* work was the same after it as before, incapacity for *obtaining* work only being the result of the second accident." The case was taken to the House of Lords, and there the judgment was reversed. ". . . the Lord Chancellor said that in his opinion, in the ordinary and popular meaning of the words, there was incapacity for work when a man had a defect which rendered his work unsalable, in any market reasonably accessible to him, and that in like manner there was partial incapacity when his work was rendered less salable. The opposite view would leave a workman uncompensated for what might be a real and direct consequence of an injury. The case was accordingly remitted to the arbitrator for the assessment of com-

[1] It is only now and then that injuries of the ciliary muscle affect the earning power. By the use of convex lenses, the impairment can, in the vast majority of occupations, be compensated. On this head see *Encyclopédie Francaise d'ophtalmologie,* Paris, 1910, Vol. IX, p. 713.

[2] We may remind ourselves in this connection that the inability to estimate distances and the size of objects, which occurs at once after the loss of an eye, endures but a very short time—certainly in adults not more than six or eight months and in children two or three weeks.

pensation.'' Now, this ability to compete (K) is composed of two elements: 1, the applicant's visual powers; 2, the judgment which the prospective employer will probably form concerning these powers. As to the first of these elements, we express it, in the formula for K, under normal circumstances, exactly as we expressed the normal act of vision (i. e., $C\sqrt{P\sqrt[4]{M}}$), ''but in the case of accidents the impaired value of the act of vision should be put in as the lowest value in the root. . . . we have given the reasons for accepting the ability to compete as the lowest value and we have likewise shown that the ability to compete is of less value in the formula for the earning ability E than the other factors, i. e., it has a smaller influence upon the value of E than the others. We have, therefore, adopted the ability to compete, K, as a root value. For, if K be reduced by an impairing of the act of vision, it becomes a proper fraction, for instance, $\frac{K}{z}$. Now the root of a proper fraction is always greater than the fraction itself; the value of K after the impairment if it is taken as a root value cannot any more be $\frac{K}{z}$, but it must be greater, for instance, $\frac{2K}{z}$. By taking K as a root, its value, in the case of a visual impairment, is greater than it would have been if K without root would have been taken into the calculation. And as the amount of the earning ability is directly fixed by the amount of the ability to compete, K exercises less influence upon the earning ability than the other factors, as soon as we insert K as root in the formula for the earning ability. The full formula being:

$$\sqrt[x]{K} = \sqrt[x]{S_2\sqrt{P\sqrt[4]{m}}}.''$$

As to the second of the elements which go to make up K, i. e., the part depending on the judgment of the employer, that part is expressed by the exponent of the root which is chosen for K. ''If we think that the esthetic differences between simple blindness of the scientific standard without injury to the looks of the eye and the loss of the eyeball, or, for instance, the formation of a bad-looking eye, as leucoma or staphyloma are greater, we may give expression to our opinion by choosing a great root exponent for the ability to compete in the case of simple blindness without deformity. By leaving the selection of the root exponent to the judgment of the calculator, sufficient room is given to the individual conception of each case; *thus our formula adapts itself to the peculiarities of the individual case and to the judg-*

ment of the physician, avoiding thereby a rigid form and doing justice to both parties.'' In view of the fact that we are often ''in the peculiar position of estimating an ocular impairment of the ability to compete when there is no real defect of working vision,'' (for instance, in the case of a man with a bad-looking leucomatous eye, whose acuity is, say .25, while the fellow eye is absolutely normal) ''we express the diminution of the ability to compete in all cases by the arithmetical proportion of the visual acuity of both eyes.'' In the case of the leucomatous individual just supposed, the numerical expression for the ability to compete would be:

$$\sqrt[10]{\frac{1+0.25}{2}\,\sqrt{P}\,\sqrt[4]{(m_1m_2m_3m_4m_5m_6)\,(m'_1m'_2m'_3m'_4m'_5m'_6)}}\text{''}$$

Because of lack of space, we cannot here enter into the numerous and ingenious applications of this formula which are furnished by Magnus and Würdemann, though these are extremely interesting and instructive. We can only say, in bidding farewell to the formula in question, that, though such an extremely elaborate hieroglyphic is by no means presentable to a jury, or, indeed, to corporation management, except in isolated instances, yet that the ophthalmo-surgical expert who has mastered the subject of ''visual economics'' and particularly the comprehensively scientific formula which we have been discussing, namely:

$$E = C\ (\text{max.})\ \sqrt{P}\,\sqrt[4]{M}\,\sqrt[x]{\frac{C_1+C_2}{2}\,\sqrt{P}\,\sqrt[4]{M}}.$$

will find himself indubitably better able to wrestle with the question as to what degree of economic loss has been sustained by a given person in consequence of some particular injury.

Questions of a general nature relating to the power of vision.

Questions under this head are chiefly these: (1) As to the possibility of recognizing persons [1] and objects under various sorts of cir-

[1] In this connection, the following, extracted from *The Law and The Doctor*, Vol. II, p. 39, may prove interesting: ''* * * the physician, testifying as to the possibility or impossibility of a certain act or thing, should remember that his evidence may be rebutted by testimony of a witness that he has performed the act or accomplished the thing which the expert has testified to be impossible. A case illustrating the pertinence of this suggestion was related to the author some years ago by a lawyer who was present at the trial. Two men had broken into the house of an old couple at night and entered the sleeping-room. The old people were awakened by the noise. The old lady, rising up, took her glasses from the head-board of the bed, and, by their aid, claimed to have recognized the men

cumstances by ordinary daylight; (2) by a gleam of lightning; (3) by the flash of a pistol; (4) by moonlight; (5) by starlight.

1. By ordinary daylight. The perception and also the recognition of persons and things by means of the sense of sight depends on the size of the object, its brilliancy, its distance from the observer, the clarity of the atmosphere, the observer's familiarity with the person or object to be perceived, his position with respect to the sun (i. e., whether gazing squarely or partly toward, or directly away from the sun) the intensity of the illumination which is shed upon the object, and, finally, the acuity of vision on the part of the observer. The ordinary test for the acuity of vision is this: The subject is placed at a distance, generally, of 20 feet (6 metres) from a card, chart, or board, on which are printed lines of isolated letters (i. e., letters unrelated in sense) of varying sizes, all the letters of a given size being printed, as a rule, in one and the same line, and a certain proportionate relationship subsisting between each letter and every other letter on the card. This proportionate relationship is based, according at least to the method most generally employed, upon the principle that the minimum visual angle is precisely one minute. Each letter, in whatever line, is constructed of blocks, or units, each of which subtends, at the distance indicated by the number of the line in which the letter occurs, an angle of exactly one minute. A whole letter subtends, laterally as well as vertically, an angle of 5′, being composed laterally and vertically, of five of the constituent blocks, or units. Now, the line numbered 20 should, as already hinted, be read by the average normal, unassisted eye at a distance of 20 feet—i. e., the distance at which the test is ordinarily conducted. The line numbered 15, is supposed to be read by the same kind of eye at 15 feet; that numbered 10, at 10 feet. The line that bears the number 30 should be read at 30 feet, and so on from line to line of larger and larger type till the line numbered 200 (which is generally the largest used) is reached—a line which should, of course, be read throughout by the average normal, unassisted eye at 200 feet. If the subject reads at a distance of 20 feet the line numbered 20,

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just as they shot and killed the husband. Upon trial of the accused, the defense introduced an oculist who testified that he had examined the eyes of the old lady and the glasses in question, and that it was a physical impossibility for her to recognize a person by the aid of those glasses at the distance at which it was testified the murderers were, as the lenses of the eyes and the glasses could not focus at that point. Counsel for the prosecution, in rebuttal, identified the glasses in question, asked the old lady to take the witness stand, and caused several men, including the accused, to stand in front of her at the distance testified; thereupon he handed her the glasses and asked her to 'pick out the men who shot your husband.' After adjusting the glasses, she peered into the faces of the several men until she came to the accused, when she promptly identified them as the men who had committed the crime.''

we express the vision of that eye thus: Vision (or simply V) = 20/20 (20/20, of course = unity, or normal). If the subject can read with the given eye at 20 feet nothing smaller than the line numbered 30, his vision = 20/30, or ⅔ the normal. If the line numbered 15, then 20/15, or 33⅓ per cent. better than even the average, normal, unassisted eye—a power of vision which is now and then found. Thus, the distance at which the subject reads is always the numerator of the fraction which expresses his visual power, and the number of the line that is read is the denominator. If the sight is normal this fraction = unity (20/20); if less than normal, the fraction is a proper fraction, and, if more than normal, an improper one. The vision of the two eyes together, assuming that the sight of each is fairly good, and that it is much the same in each, as in the other eye, is often a little better (a fraction of a line, in fact) than that of the better eye alone.

Inability to read Snellen's line numbered 20 at a distance of 20 feet (i. e., subnormal acuity) may arise from errors of refraction (which, in almost every instance, are correctable by glasses) by obstruction to the passage of the light through the eye to retina and optic nerve (as by any opacity in the cornea, the aqueous humor, the lens—cataract—or the vitreous body) by pathological conditions of the retina or optic nerve, the optic chiasm, the optic tract, or, finally, the cerebral portion of the visual apparatus.

Assuming, now, that the eye has normal acuity of vision (naturally, or after correction by means of lenses in case subnormal acuity is due to an error of refraction) how far can such an eye (an eye, that is, with 20/20 acuity) perceive a man of ordinary height, out of doors, by ordinary solar illumination? According to various experiments, such an eye perceives an ordinary man, in ordinary attire, on level ground, (assuming the observer himself to be a man of ordinary height, and with the sun not in his eyes) at a distance of 3½ miles. Brilliant attire, exceptional clarity of atmosphere, very abundant sunshine, and unusual stature in either the observer or the observed, may, combined, increase the distance by as much as perhaps a quarter of a mile. On the other hand, dense fog, diminished illumination, rough ground, and diminutive stature in either the observer or the observed, reduce the distance greatly; in fact, a fog alone may reduce it to a very few feet.

Different, indeed, is the power to recognize from the ability merely to discern. Here, also, two new elements come in: First, presence or absence of personal peculiarities in the observed; second, the knowledge or the lack of knowledge concerning these, on the part of the observer. Persons with marked peculiarities can be recognized, in broad daylight, by those who know them well, at 110 yards (100 metres). A person

of marked peculiarities can be recognized by one who knows him only slightly, at 70 to 80 yards. A person devoid of peculiarities can be recognized by a person well acquainted with him, at about 70 or 80 yards. Finally, a person devoid of marked peculiarities can be identified by those who are only slightly acquainted with him, only at the rather surprisingly short distance of 25 to 35 yards.

As to the smallest objects visible to the unassisted eye, it may be observed that lines (not, of course, in the geometrical sense) are more perceivable than are squares, circles, triangles and the like, presenting the same identical extent of surface to the eye. The smallest black square on a white ground, or white square on a black ground, that can be seen by the normal human eye, under ordinary (indoor and indirect) solar illumination, is about the 1/500 of an inch. Brilliant particles, such as grains of gold-dust, can be perceived by the eye even when presenting so little area as 1/1,125 of an inch. "Lines," as stated, are more perceptible than figures more compact. Thus, opaque threads, held between the naked eye and a window can, by ordinary, indirect solar illumination, be discerned though only 1/4,000 inch in diameter.

2. By lightning. The question has arisen, especially in criminal trials, as to the possibility of recognizing a person when the only illumination consists of a gleam of lightning. It arose, for example, in the thread-bare, if also classic, instance of the lady who, returning home from India, declared that she saw distinctly, and could afterward identify, a man who was "robbing her trunk in the cabin of a vessel, on a dark night." Tidy,[1] declares "that a flash of lightning is in many cases, but by no means in all, amply sufficient for purposes of identification." Further, that he "was able on one occasion to detect a black hair-pin on the ground by a flash of lightning, and to pick it up when the next flash came."

3. By the flash of firearms. The possibility of recognition by means of the flash of a firearm has also formed the ground of questions asked at a number of criminal trials. On this head there is little satisfactory information, thus far, to be obtained. Cauvet, however, cited by Allen McLane Hamilton,[2] sets forth the following conclusions as having been drawn from experiments conducted by him: "(1) That the person firing a pistol may be recognized if the observer is placed very near him—say five paces—and at the side of the line of fire; (2) that he may be recognized when the discharge has been in a close place of small dimensions, and the observer is in a stooping posture or squat-

[1] Tidy. *Legal Medicine*, New York, 1882, Vol. I, p. 213.

[2] Hamilton (ed.) *A System of Legal Medicine*, New York, 1900, Vol. I, p. 191. (Hamilton gives no further citation than merely the name of Cauvet.)

ting; (3) that the chance of distinguishing the person firing is affected by the quality of the powder employed, the best English powder enabling the observer, when near or by the side of the person firing, both to see and identify him."

4. By moonlight. A person with marked peculiarities, illuminated by the best of moonlight, can be identified by an intimate acquaintance no farther than 16 to 18 yards.

5. By starlight. Under the clearest starlight, however, no farther than 3 to 4 yards.

Flashes of light ("stars" or "sparks") from blows on the head cause no illumination of external objects; they are "subjective" merely. No recognition of persons or things in the external world is, therefore, possible by means of them. The matter would hardly seem to be worth mentioning, but the question has been actually asked of expert witnesses.

The condition of the eye after death.

The special significance of the ocular signs of death arises from the fact that, in lego-medical investigations, it is now and then desirable to determine as nearly as possible the fact of death and, occasionally, the very time of death.[1] In ordinary circumstances, the presence of death is easy enough to make out. Even if a corpse is covered with a sheet, there is something in the posture, or else in the motionless rigidity of the limbs, that tells us almost unmistakably that death is below. Sometimes, however, the diagnosis of death is difficult; then it is that we need the assistance of art.

The signs of death relate to three periods: 1, The stage of transition; 2, the cadaveric state; 3, the stage of putrefactive processes. These terms do not seem to require elucidation.

The signs in the stage of transition (to some extent also in the cadaveric state) have reference to four sets of organs: 1, The circulatory system; 2, the respiratory system; 3, the voluntary muscular system; 4, the eyes.

Only the signs relating to the eyes, of course, concern us here, and further, even these chiefly in the stage of transition.

1. The adnexa. The skin of the lids is pale, of course, as death approaches, or actually sets in, excepting in certain diseases, but this palpebral pallor is of very little value as a sign of death. What about

[1] As a single instance of the necessity which now and then arises for establishing with the utmost accuracy the very moment when death takes place, we may mention the case where the descent of property down one line or another, depends upon the answer to the question of whether A died first or B.

the open or closed condition of the lids? Much discussion has been wasted on this question. The matter as a whole, however, may be summed up thus: In cases of "natural" death (i. e., gradual dissolution as a result of disease) the lids are as a rule, just about half open, both during the stage of transition and also in the cadaveric state. Hence, in fact, the well-known necessity of "closing the eyes of the dead." In cases of drowning, on the other hand, the lids are apt to be puffed (edematous) and more or less tightly closed, while, after sudden death from gun-shot wounds, the lids stand widely apart. To all these rules, however, there are numerous exceptions.

A deep groove, in the cadaveric state, appears between the upper lids and the eyebrows, but this appearance, too, is not to be regarded as a positive sign of death; for it sometimes shows itself when death has clearly not occurred, and, on the other hand, is often absent even when the body as a whole has well advanced into the stage of putrefaction.

2. The globes. The eyeballs, always in the cadaveric state and almost always in the stage of transition, retract, and this sudden or gradual drawing backward of the eyeballs into their sockets, imparts to the death agony one of its most nearly characteristic features. Nevertheless, as a certain sign of death, the retraction of the globes is not at all to be trusted. The phenomenon, in fact, occurs in people who, though very sick, recover, and, on the other hand, in a certain proportion that die, the appearance is either not noticed at all, or else is very slight. In the stage of transition the retraction is due to spasm of the extrinsic muscles; in the cadaveric state, to *rigor mortis* of the same parts. When deferred till the cadaveric state it is one of the earliest symptoms of that condition, for *rigor mortis* almost invariably sets in first either in the heart muscle or in the extrinsic muscles of the eye.

The direction which is given to the globes by the passage from life into death is such that the optic axes are rendered parallel or even a little divergent. This is the "staring into vacancy" of the novelists. This sign, too, is not reliable as an indication of dissolution, because it often occurs in serious illness without death, while, on the other hand, an actual convergence of the visual axes has been observed, though rarely, after undoubted dissolution.

3. The conjunctiva and cornea. These structures become insensible very early in the stage of transition, but, because the same thing happens so often in serious diseases, the sign is absolutely worthless. The cornea, it is barely worth mentioning, retains its sensibility longer than does the conjunctiva.

The thin gelatinous film which forms upon the cornea as a person dies, is one of the more impressive phenomena of dissolution, furnishing indeed, as it does, the most important element of ''the finely ruined eyes of death.'' When this film is seen to form, a person is almost surely dying. And yet, after all, not quite surely, for, as a fact, the same identical phenomenon has been witnessed in the living—for instance, in the course of serious cases of typhoid, of meningitis, and various cerebral affections—who afterward recovered. However, in the living, it is almost always accompanied by the tell-tale symptoms of active inflammation, whereas, in the dying and the dead, the exsanguinated vessels of the sclera and conjunctiva give an opposite account.

The film in question is very delicate and fragile, and easily wiped away. It seems to consist of lymph and other fluids, which exude through the ocular tissues.

Wrinkling of the cornea has also been set up as a characteristic sign of death. It seems to be dependent on the same transudation of intraocular fluids that results in the formation of the corneal film. As a result of this transudation, the intraocular tension diminishes, and so the cornea wrinkles. The wrinkling seldom becomes detectable till the corneal film has pretty plainly formed, hence the sign in question is a characteristic of the cadaveric state rather than the stage of transition. Its value as a sign of death is therefore subordinate.

4. The sclera. The lethal discoloration of the sclera has been alleged (like all the other ocular manifestations of dissolution) to be an absolutely certain sign of death. This sign, however, considered alone, is worth but little more than any of the other signs, perhaps not quite so much as some of them. It possesses the advantage (which is also in some respects a disadvantage) of appearing very early. In fact, in cholera patients it appears as early as eight hours prior to death. It consists of a blackish discoloration, which first appears in the outer scleral triangle, i. e., the space which lies between the outer margin of the cornea and the two lid margins as far as the outer canthus. Next it appears in the inner scleral triangle. Finally, it forms in the portion of the sclera that is covered by the upper, and then in that which is covered by the lower lid. It appears more rapidly and more certainly in a warm than in a cold room, and is very often seen in those who die of phthisis pulmonalis and typhoid fever. It is said to consist partly of subconjunctival ecchymosis and partly of choroidal pigment. Its nature, in fact, has never been exactly determined.

5. The iris. When a person dies, does his pupil contract or dilate? The question would seem to be a simple one, and one very easy to

answer. Nevertheless, a great deal of bitter controversy has been waged about this easy-seeming inquiry. We cannot here afford to revive a discussion which has never appeared to be profitable, and which, besides, has given excellent proofs of its own dissolution. However, it seems to be pretty well settled that, at the very moment of death, the pupil, in the vast majority of cases, dilates. This dilatation, however, continues for a few hours only; with the setting in of *rigor mortis,* the pupil contracts. For one hour after death the pupil responds to eserin and atropin; but not for any longer time. It responds to galvanism, in many cases, for as long as five hours.

6. The fundus. If, at the time of death, or a little while thereafter, the gelatinous film upon the cornea be removed by first moistening it and then wiping it away, the ophthalmoscope can be employed to some advantage. By means of this instrument it has been determined that, at the moment of death, sudden and very striking alterations take place in various portions of the fundus. The papilla becomes anemic, as it were in a flash, and the reddish color of the remainder of the field turns from the normal red or pink almost as suddenly to a sickly yellow. The arteries disappear entirely, and the veins become much smaller, and rather irregular and broken. In all this, however, there is nothing absolutely declaratory of death; similar conditions have been observed in syncope and lethargy.

Is there, then, no ocular symptom at all that will serve as an indisputable sign of death? There is absolutely none. However, when taken as a whole, the ocular signs of death are well-nigh incontestable, especially when supported by tests of general character, such, for instance, as failure of the heart and lungs to respond to stethoscopic examination, and failure of a finger to become cyanotic after a ligature has been tightly placed around it. Still more certain, of course, are such signs as general *rigor mortis,* cooling and suggillation (postmortem lividity) while, as an absolutely undeniable indication of death, comes putrefaction.[1]

Post-mortem optograms.—Among the laity there obtains a belief that the retinas of those who have perished by assassination retain for some time a photographic image of such persons as last appeared before the eyes of these murdered people. A large number of motion-picture plots have, in fact, been built upon this conception. In this idea, however, there is only the merest shadow of an atom of truth. Vernois (in 1870) having made some photographs of a murdered man's

[1] Perhaps it may be as well to remind ourselves that the earliest sign of decay is a spot of green on the belly, generally in the neighborhood of the umbilicus. Of the internal organs, the liver is, as a rule, the first to decay, the uterus the last.

retina, thought that his pictures exhibited the figures of a man and a dog in the very attitude and posture of attack. These photographs he displayed with some pride to the Society of Legal Medicine in France, and, in fact, to many other physicians in other places; but, unfortunately, he never quite succeeded in getting any other medical person to believe that the pictures represented a man and a dog. In fact the pictures, if such they were, were altogether too vague and indefinite to be of any practical service in the detection of evil-doers.

Kühne, of Heidelberg, later placed gratings in front of rabbits, then killed the rabbits very suddenly and, without any delay whatever, proceeded to make a photograph of the retinas of these animals. Very distinct pictures of the gratings were in some cases secured. However, the killing of the animals had to be practically instantaneous, and the making of the photographs well-nigh as rapid. A man who, by methods such as these, could make successful pictures of murdered people's retinas would have to be upon the scene in ample time to catch the murderer by a very much simpler plan.

The ocular signs of sleep.

Sleep is sometimes simulated, but the fraud is easily found out. The eyeballs in genuine sleep, for one thing, are nearly always absolutely motionless, whereas, when the sleep is only feigned, the globes are seen to move about a little beneath the closed lids. If an upper lid be lifted, the fact will be observed, in genuine sleep, that the pupils are very small, while, as the subject wakens, the pupils dilate extremely wide, even in the presence of strong light.

Ocular indications of poisoning, burning, etc.

The effects of the commoner poisons on the eye may be very briefly stated as follows:

Alcohol.—Conjunctival injection and swelling, both in acute and in chronic poisoning. In chronic poisoning, there is present, in addition, a paresis of the *orbicularis palpebrarum*, combined with anesthesia of the cornea, so that involuntary winking is almost entirely abolished; hence, "the fixed, unwinking stare" of the hard drinker, when sober as well as when drunk.

Arsenate of copper.—This chemical is employed in the manufacture of artificial flowers, confectionery and in fancy baking. The ocular symptoms produced by this substance in those who work therewith habitually, are conjunctivitis and swelling of the lids.

Belladonna and atropin.—Swelling of the lids, excessive lustre of

the corneæ, mydriasis, and paralysis of the accommodation. Exophthalmia has been observed, as a result, no doubt, of paresis or paralysis of the recti, together with a similar condition of the orbicularis, permitting the lids to be widely separated by the forward-pushing globe.

Chloral hydrate.—The prolonged employment of this drug produces conjunctivitis and severe itching of the lids, inside and out.

Chloroform and ether.—During the stage of excitement, pupillary dilatation. Thereafter, progressive pupillary contraction. In the "surgical state" the pupils are immobile, as well as contracted.

Curare.—Exophthalmia, conjunctivitis, and excessive lacrimation.

Digitalis.—Exophthalmia, together with fixity of the visual axes and conjunctival injection.

Illuminating gas.[1]—Diminution of visual acuity, with contraction of the visual field; dilatation of the retinal veins and contraction of the arteries. Persistent bilateral hemianopsia after recovery, has been recorded. There is sometimes paralysis of the various ocular muscles, extrinsic and intrinsic, accompanied or unaccompanied by exophthalmia. When the recti are paralysed, there is always exophthalmia.

Naphthol-B.—When used for a considerable length of time, even externally, this drug not infrequently produces cataract and various alterations in the choroid and retina.

Nicotin.—Exophthalmia and corneal brilliancy.

Opium and its alkaloids.—Myosis and spasm of the accommodation, together with dimness of the cornea—producing the so-called "fishy" look.

Prussic acid.—Exophthalmia and diplopia. After death, the eyes are fixed, prominent and wide open, and are possessed, furthermore, of a singularly life-like expression.

Quinine.—This drug sometimes, in excessive doses, produces a peculiar fundus condition known as "quinine amaurosis." There is extreme contraction of the retinal arteries, and the papilla is very white. Recovery not infrequently occurs, but there is often a permanent peripheral contraction of the visual field.

Strychnin.—Prominence of the eyes and fixity of the visual axes, especially during the convulsions.

Thyroid gland.—Optic neuritis, followed by optic atrophy.

Burning—After extraocular burns, the following ocular symptoms

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[1] "Nearly one-half of the accidental poisonings in New York City in 1888-92 were by illuminating gas, and the same agent was used by suicides more frequently than any other except paris green and 'rat poison.' "—R. A. Witthaus in Witthaus and Becker's "*Medical Jurisprudence, Forensic Medicine, and Toxicology,*" New York, 1896, Vol. IV, p. 848.

have been noted: retinitis, chorio-retinitis, retinal hemorrhages, neuritis and optic atrophy.

Hanging.—Puffing and blueness of the eyelids, exophthalmia, and conjunctival injection. Punctate ecchymoses of the conjunctiva have been observed, but not at all so frequently as after strangulation and suffocation.

Strangulation and suffocation.—Before death: The eyes are livid and prominent and there are often hemorrhages from the conjunctivæ. Subjectively, the vision is lost soon after the beginning of the process. After death: Exophthalmos, redness of the conjunctivæ, and minute conjunctival ecchymoses. The punctulation of the conjunctiva is said to be well-nigh characteristic.

The ocular signs of identity.

Rather often, sometimes even in the dead, the eyes and their adnexa afford most valuable indications of identity. These indications may be classified as (1) anatomical, (2) pathological, (3) professional.

1. *The anatomical signs.*—These relate to the brows and lashes, the lids, the irides, and the sclerotics.

The *brows* are seldom characteristic of the individual, but they often afford some slight indications of identity. Thus, as to the matter of color and texture, it is well known that the structures in question vary from blond to black and from silky-fine to exceedingly harsh and coarse. Years do not so often or so early alter the color of the brows as they do the hair of the head. As to form, in some individuals the brows are straight, in others arched; when arched, they take, in some, a downward inclination at the outer ends, in others, an upward. In some persons they unite at the root of the nose to form one single band.

Changes in the color of the hair often occur naturally. Children's hair gets darker with increasing age, while the hair of adults gets lighter.

The eyebrows and lashes, as well as the head-hair, are now and then colored artificially by those who desire to conceal their identity. Oftenest employed for the purpose are the salts of lead, silver and bismuth, in solution. The changes in color are due to the combination of these metals with the natural sulphur in the hair, forming the dark metallic sulphides. Lampblack, rubbed up with some fatty substance, is now and then used as a hair-dye.

The fact of artificial coloration of the hair is, as a rule, very easily detected. If lampblack has been used, washing the hair with ether will readily expose both the fraud and the natural color of the

hair, since, when the ether dissolves the fatty substance which acts as a menstruum for the dye, the dye is no longer adherent to the hair, but comes away in the ether, leaving the hair in much its natural condition.

To detect the presence of a metallic dye, wash the hair in slightly acidulated water; then test the water chemically for the presence of the metals above-mentioned—lead, silver, and bismuth.

The microscope is often useful for the detection of artificial coloration of the hair. If fatty pigments have been employed, the microscope reveals the presence of the fatty particles plainly. Sometimes, too, this instrument shows places on the individual hair which the dye has failed to affect.

The *lashes* are naturally pigmented either exactly like the brows and the head-hair, or just a little lighter. They are dyed artificially in the same way as the brows and the head-hair, and the fraud is, of course, detected in precisely the same manner.

The *lids* afford a variety of signs. Thus, age is often indicated, approximately, by the wrinkling of the lids, especially at the outer canthi ("crow's feet") and by the puffing of the lower lid especially ("money-bags"). The skin of the lids also thickens with age and becomes in color brownish or yellowish.

The *iris* is in infants nearly always of a light blue. In later childhood, however, it assumes the particular color which it is to retain throughout the whole of life, excepting in senility, when the color again becomes perhaps a trifle lighter.

Congenital anomalies of the irides, the chief of which are colobomata, heterophthalmos (difference in hue of the irides in the same person) have been considered in a former portion of this article. Suffice it here to remind ourselves that such distinguishing peculiarities are possessed of the utmost value as a means of establishing identity.

The *sclera* is in some persons yellow, in others bluish-white, in still others clear white. These differences are often racial; thus, the Jews are noted for the perfect albugineity of their scleræ. Some persons possess, congenitally, spots of pigment in their scleræ, and these, of course, possess much value as a means of identification.

2. *The pathological signs.*—It would be improper to attempt to mention all the pathological conditions in the various ocular structures which, on occasion, could become of greater or less service in the establishment of identity. The chief pathologic signs, however, are the following: Scars of all sorts in the skin of the lids and brows;[1] se-

[1] Including, of course, the tattoos produced by explosions of fire-damp and of gun-powder. On the methods whereby these important kinds of tattoos may be

baceous cysts; slit canaliculi; cicatricial conjunctivæ, resulting from trachoma; pinguecula; pterygium; cataract; the characteristic scars produced by the various bulbar operations; and, finally, the numerous pathological appearances of the fundus.

We ought to add that lashes and brows—as well as the hair of the head—have not turned white from grief or fear in a single night,[1] and, further, that hair is often much darker on its return after loss during typhoid fever and other infectious diseases.

3. *Professional signs.*—The chief of these relate to the various sorts of dust produced in the work of different occupations, and which cling to lashes and brows, sometimes in spite of repeated washings. Thus, for instance, coal-miners, chimney-sweeps, firemen, engineers, and coal-heavers exhibit a dusting and staining of the brows and lashes by coal or soot; locksmiths show on the same parts a dust composed of copper filings; blacksmiths have reddened scleræ and numerous minute scars on corneæ and lids; millers and bakers carry flour in the same situation, while marble-cutters and stone-breakers exhibit, as is well known, on brows and lashes, a plentiful quantity of siliceous dust. There are many other occupations which leave a characteristic powder on the hairs about the eye, even the names of which it is not necessary to mention. We should not forget, however, in this connection, the tanned and thickened skin and yellowed and thickened conjunctivæ of outdoor workers, as well as the special liability of such persons to pinguecula and pterygium.

III.

OPHTHALMO-SANITARY LEGISLATION.

Ophthalmo-sanitary laws in the United States.

The laws enacted for the prevention of injuries to, and diseases of the eye, are, in any country, "few and far between." Nevertheless,

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distinguished, see that division of this article, entitled "The commoner injuries with which the ophthalmo-surgical expert has to deal."

The tattooing produced by explosions of fire-damp occurs not only in the skin of the lids, but also on the conjunctiva of the palpebral, as well as the bulbar portion. Thus, I had, at the time of writing this paragraph, under treatment, a coal-miner, on the inner surface of whose right lower eyelid were plainly visible several characteristic marks (ancient) produced by fire-damp explosions. There was not a single spot of the sort in any other part of the eye, or of the fellow eye, or even on the face or head. It would be quite possible to assert, with a high degree of certainty, merely on the strength of these tiny marks, that the subject was a coal-miner.

[1] Hair has now and then *appeared* to turn white in a very brief space of time. Thus, in a case that was known to the present writer, a lady, on the loss of her daughter, decided to give up the "vanity" of dyeing her hair. When next she

such laws exist, and are most conveniently divisible, as regards America at least, in these two main classes:

1. Laws devoted solely to the prevention of injuries to, and diseases of, the eyes.

2. Laws which, though embracing other matters, nevertheless contribute partly or indirectly toward the prevention of such injuries and diseases.

Neither of these kinds of laws can here be treated *in extenso.*

(1.) Among the most important of the first named enactments are those relating to the prevention of blindness from *ophthalmia neonatorum.* These are of Cleopatra-like variety—long, short, foolish, wise, and every one imperfect. The first jurisdiction in which a law of the character in question was passed was Maine (in 1891—precisely ten years after the announcement by Credé of his marvelous discovery[1]). New York followed in 1892 (April 18) and, on the next succeeding day (April 19) Rhode Island became a portion of the goodly company. In 1893 Minnesota, and, in 1894, Ohio and Maryland, fell in line. Eighteen ninety-five was a veritable *annus mirabilis,* no fewer than six states passing ophthalmia neonatorum laws within that twelvemonth—a record which was only equalled in 1911. Today there is hardly a state in the Union which does not show some law, either good or bad, workable or unworkable, on its statute books or session laws with respect to the disease in question. But the quality of these laws? That is a different matter. There is, however, scarcely a single law which does not show forth some valuable provision. On the other hand, there is scarcely a statute which does not show some serious hiatus or fundamental misconception of the very situation which it is the object of the law to improve. Some statutes place the entire matter in the hands of the State Board of Health. Others are founded wholly upon the very mistaken supposition that blindness from the disease in question is forever and eternally due to a fault on the part of an ignorant midwife. Others require, and properly, that physician or midwife, whichever has been in attendance at the birth, shall report all cases of "inflammation of the eyes" to a public official—for example, "the parish health officer," the drawer of the bill having apparently believed that, the case once "reported," the eyes would get well of themselves. The most important provision of all is, in fact, almost universally omitted—i. e., the provision that whoever presides at a birth—

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presented herself among her friends her hair was the color it really had been for many years—*i. e.,* snow white. However, the lady in question at once (though innocently) acquired the reputation of having become white-headed through grief in a single night.

[1] See, in this *Encyclopedia,* **Credé, Karl, Siegmund Franz.**

whether midwife or physician—shall *use the Credé drops, and thus render unnecessary the making of any sort or kind of report or the institution of any other sort or kind of treatment.*

For a thorough discussion of the laws relating to ophthalmia neonatorum, as well as for a model law, the reader is referred to an article by Dr. Frank Allport in this *Encyclopedia*, entitled **Ophthalmia neonatorum.**[1] See, also, **Blindness, Prevention of, Conservation of vision** and other pertinent headings in this *Encyclopedia.*

Leaving the subject of ophthalmia neonatorum, about which very much more could be said, here is a very useful Connecticut statute, which, so far as I know, has never been copied into the laws of any other state.[2] "Every person, firm or corporation using *stained, painted, or corrugated glass in factory windows*, where the same is injurious to the eyes of the workmen therein, shall remove the same upon the order of the factory inspector."

The various laws requiring the use of *blowers, hoods, etc., in connection with polishing machines, etc.*, have in view almost exclusively the protection of the eyes. Nearly all the states possess such laws at present, and, of these, the following from New Jersey may very well stand as typical:[3] "Sec. 14. All corporations, firms or persons conducting a manufacturing business . . . where emery wheels or emery belts of any description are used, either solid emery, leather, leather covered, felt, canvas, linen, paper, cotton, or wheels or belts rolled or coated with emery or corundum or cotton wheels used as buffs, shall provide the same with blowers or similar apparatus, which shall be placed over, beside or under wheels or belts in such a manner as to protect the person or persons using the same from the particles of the dust produced and caused thereby, and to carry away the dust arising from or thrown off by such wheels or belts while in operation, directly to the outside of the building, or to some receptacle placed so as to receive and confine such dust . . .

"Sec. 15. . . . Each and every such wheel shall be fitted with a sheet or cast-iron hood or hopper of such form and so applied to such wheel or wheels that the dust or refuse therefrom will fall from such wheels or will be thrown into such hood or hopper by centrifugal force and be carried off by a current of air into a suction pipe attached to some hood or hopper." See, also, **Blindness, Prevention of.**

Thus much for the legal enactments in the United States tending

1 Also to an article by the same writer in *Ophthalmology,* for January, 1916.
2 *General Statutes,* 1902, sec. 4518.
3 *Acts of 1904,* chap. 64, secs. 14 and 15. (Several of the immediately succeeding sections are also interesting in the present connection.)

toward the prevention of ocular injuries and diseases; and, truly, by any one who investigates this class of our legislation at all thoroughly, it is readily perceived that in this country there exists a very great need of further determinate ophthalmo-sanitary legislation. For instance, *the sale of explosives for use on the Fourth of July and other holidays* should be much more carefully restricted, or, still better, should be prohibited entirely. At present, nearly all such matters are left to local ordinance, whereas each state should enact a statute on the subject, and every state prosecutor should see that the law is strictly enforced within his territorial jurisdiction. A civil statute, making the seller of explosives to persons under age answerable in damages for all injuries resulting from such sale, would exert, beyond question, an extremely deterrent effect. Such a law, for one thing, would not depend for its enforcement on the vigilance of public prosecutors.

Still another matter vainly demanding legislative attention is *the fitting of glasses by incompetent persons.* It is not perhaps an exaggeration to say that nine-tenths of all the glasses fitted, or misfitted, in this country are obtained from the hands of grossly ignorant men, persons who are not physicians in any sense whatever and who have never received even the slightest medical training. Each of these incompetent persons almost invariably makes himself known throughout the community as "eye-doctor," "eye-specialist," "ophthalmologist," and the like, by which misnomers he succeeds in leading the public to suppose that he is a physician paying especial attention to diseases of the eye. Unfortunately, legislators, forgetting that the only possible justification for the narrowness of specialism is the broadest possible preliminary training in the different general medical branches (from which no specialty can properly be dissevered, except in the field of actual practice) are generally, in fact almost universally, disposed to regard the treatment of eye-troubles by those who are only spectacle-fitters as merely a further and praiseworthy development of the modern idea of specialism. The consequence is that legislation, instead of tending to oust these people from ophthalmic practice, tends yearly more and more firmly to establish them therein. A number of states now have legislation, the object of which is to fence about and safeguard these unqualified practitioners. On the other hand, the medical profession (inclusive of ophthalmologists) seems to have gone sound asleep upon this subject. Many family practitioners, in fact, actually refer their "spectacle work" to the most outrageous quacks, and do so as a matter of routine.[1]

[1] In an excellent paper by Dr. James A. Spalding, of Portland, Maine, read at the meeting of the Maine Medical Association, July 1, 1913, entitled "The

Then another affair demanding attention, but very unlikely to get it, is *the continual sale in enormous quantities of eye-drops, eye-salves, eye-batteries, and the like,* not only by respectable pharmacists, but also by "wheeling strangers of here and everywhere." [1] In towns of considerable size the institution should be insisted upon of *strictly prescription drug-stores,* i. e., those which do not deal in fraudulent medicines. Then all the physicians in the town should send their prescriptions to such stores.

Another deficiency in American ophthalmo-sanitary legislation lies

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Eye: Its Connection with Diseases and Injuries of the Body," occurs the following very relevant passage: "Hundreds of books and thousands of papers have been written in the past, and will continue to be written so long as life endures upon this world, on the interdependence of the eye, and diseases and injuries of the body. For all that, the legislature of Maine saw fit four years ago to set its denial upon this well-known truth, and to assert that there was no connection between the organ of sight and the human body. It will forever remain a source of regret that such an ignorant law should have been passed, but politics, money, a powerful and persistent lobby overpowered our small band of protesting physicians. So far, under this law, nothing has been gained for the people, the medical profession has lost ground, and ignorant, uneducated men are allowed to practise one branch of pure, absolute medicine as they see fit. The certificates under which they carry on this practice flaunt in the face of the public the false assertion of 'examinations of fitness,' that have never been passed, and in the four years of the presence of this useless law upon our statute books, not a single educated man has been added to the ranks of the exempt and often unfit." In the experience of the present writer a lawyer member of the legislature can often be reached (during the pendency of an "optometry" bill) by the following argument: What would you think if I were to offer in this legislature, seriously, a bill proposing that persons who have never secured a license to practice law, should be permitted to practice real estate law, or personal injury law, or probate law, or patent law, or any other legal specialty, only after six weeks or two or three months of study, of these branches alone and the passing of a so-called "examination" before a board, not one member of which was a lawyer or had ever secured a license to practice law? The answer always is, in effect: I would think you did not understand that no one can practice properly a legal specialty who has not received an all-round legal training. Then I answer: This same principle is true in medicine—with, however, a very important difference, namely, that he who loses me my patent or my farm, loses me what, comparatively speaking, is "trash," while he who loses me my vision or my life has made me "poor indeed."

[1] The subject of the graduate optician (who not infrequently fits glasses for nephritic retinitis, ocular syphilis, etc., until the time when a cure could be effected has forever gone by) the prescribing pharmacist, and the wheeling stranger will *not* be considered hereafter in connection with the laws of other countries. Suffice it to say that, in every civilized land on earth, so far at least as the writer has been able to ascertain, the wail for reform in these matters goes up to heaven continually and vainly. *Populus vult decipi.* Thus, for a single example, take poor France, as voiced by Chevallereau in the *Encyclopédie française d'ophtalmologie,* Vol. IX, p. 777: "Notre domaine, que d'aucuns trouvent et avec raison déjà bien étroit, est constamment envahi par un grand nombre de braconniers qui exercent sur nos terres de véritables brigandages. Les pommades et les eaux pour les yeux sont vendus par un grand nombre de pharmaciens, qui, ici comme toujours, se trouvent aux premiers rangs de nos concurrents; les sœurs de l'hôpital de Saint-Germain-en Laye vendent une eau qui guérit la cataracte; un restaurant situé près de la Bastille donne â qui en désire l'eau des Quatre-Sergents qui guérit tout. Ces exemples sont pris entre plusieurs mille.

"L'humeur de nos confrères s'est surtout élevée depuis quelques années contre les opticiens qui ne se bornent pas à exécuter nos ordonnances, mais prescrivent d'eux-mêmes et fournissent des verres pour tous les genres de réfraction * * *."

in the fact that in only seventeen states of all our forty-eight, have statutes been enacted, looking toward the establishment of *medical inspection of public school children.*[1] The states in question are: Connecticut (1899, with reference to the children's eyes alone), Massachusetts (1906, with reference to both sight and hearing), Colorado (1909, covering the eye, ear, nose and throat), Maine, Pennsylvania, Indiana, Utah, Vermont, North Dakota, West Virginia, New Hampshire, New Jersey, New York, Maryland, Wyoming, Delaware, Rhode Island. Of all the defects found in school children in this and in European countries, those of vision are by far the most numerous; hence the importance from the ophthalmic viewpoint of inspection in the public schools. Just as in the case of the laws relating to ophthalmia neonatorum, the school inspection laws are of Cleopatra-like variety—practical and impractical; serious and humorous, serio-comic and absolutely farcical. Tests for poor vision and poor hearing are, in some of the states, made by the teacher, yet, nevertheless, much good has been accomplished. Nowhere in the United States, so far as I know, are provisions made for the institution of separate classes for children with defective sight—like the *Nebenklassen* of the Germans—or separate schools for children suffering from trachoma [2]—such as exist in Italy.[3]

Every state should, as a matter of course, provide for medical inspection of its public schools, both by general practitioners and by specialists. The provisions should be absolutely mandatory and state wide in their application. Then, too, although much should, as a matter of expediency and perhaps necessity, be left to the conscience and

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[1] To be sure, a little has been done, here and there, by virtue of local powers. Thus, school nurses have throughout the country been installed in the public schools of some of our larger cities—always, by the way, with excellent results. See on this head The Value of the Nurse in the Public School, by Thomas A. Woodruff, M. D., Chicago, in the *Bulletin of the American Academy of Medicine,* Vol. X, No. 5, Oct., 1909. A case in Minnesota holds that school boards can enforce medical inspection by virtue of their general powers—i. e., regardless of the existence or non-existence of a statute. The reason given was that "no system of education, although designed solely to develop mentality, would be complete which ignored bodily health." (State *ex rel.* Stoltenberg *vs.* Brown, City Comptroller, 128 N. W. R. 294.)

[2] For an example of what can be done where proper intelligence and determination exist, the reader is referred to an article by F. W. Carruth, entitled A Municipal Crusade Against Trachoma, *No. Am. Rev.,* 177: 766-74. This crusade was nobly led by Dr. Richard Derby and Dr. Ernst J. Lederle.

[3] An excellent article on The Medical Inspection of Public School Children is that by Dr. G. W. Rice, of Champaign, Ill., in the *Illinois Medical Journal,* for March, 1910, p. 328. Another is that by Dr. Frank Allport in *Ophthalmology,* for July, 1915, entitled State Legislation Concerning the Examination of School Children's Eyes, Ears, Noses and Throats. Good books on the subject are: Kelynack, *Medical Examination of Schools and Scholars* (London, 1910); Steven, *Medical Supervision in Schools* (London, 1910); Cornell, *Health and Medical Inspection of School Children* (Phila., 1912).

discretion of teachers and inspectors, yet very much might well enough be made a matter of certainty by hard and fast rules. Thus. Javal's dictum that buildings surrounding a schoolhouse should not stand closer to the school than twice their altitude, might very well be insisted on in every case. Again, such matters as temperature and ventilation might be the subject of fixed rules. Inspectors should be required, under appropriate penalties, to see that cards are issued to parents, directing the latter's attention to any defects of a physical nature occurring in their children. Monthly inspections should be required [1] and the occurrence ot contagious diseases should be a signal, always, for the removal of the afflicted scholar, or scholars, until such time as his or their reappearance could be made without danger to other persons. School books should be printed in type neither above nor below certain standards of size, and on paper absolutely opaque and of a dull finish. Larger sized type should be required for the younger children and for the bodies of the pages than for older students and foot-notes.[2] In towns of a thousand or more inhabitants there should be separate schools, or classes, for children with defective vision—less, say, than 1/5. Indigent children needing glasses should have these furnished at the public expense.[3] As to school furniture, the front edge of the seat should be required to extend not less than 2 nor more than 4 inches forward of the back edge of the desk; the seat should be at an approximate distance from the desk of ⅛ the pupil's height; the top surface of the desk should be inclined in the direction of the pupil at an angle of 15° to 20°; and certain other regulations relative to school furniture, not possible to be mentioned here, should be made the subject of statutory enactment. Finally, in towns or cities with populations exceeding ten thousand, school nurses should be employed, and should be vested with appropriate and adequate authority.[4]

(2.) Laws which only indirectly, or partly, have for their object the prevention of eye diseases and injuries.[5]

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[1] Our active little neighbor across the Pacific got round to this many years ago.

[2] The ophthalmic section of the American Medical Association should, in fact, draft a circular to be sent to every publisher of books of any sort or kind within this country, suggesting (with reasons) that the use of glossy papers in books be discontinued, saving and excepting solely when the presence of half-tones render the employment of glossy paper indispensable. Suggestions should also be made with regard to "leading" and to the size of type, both for body-work and for footnotes. Publishers are exceedingly careless with regard to these matters, particularly with regard to the unnecessary use of glossy papers.

[3] By which I do not mean at the expense of some individual oculist.

[4] For a full discussion of the general subject, as well as a model law, see, in this *Encyclopedia*, **Medical Inspection of School Children**, also **Conservation of Vision.**

[5] Unfortunately, the employer's liability law which has been enacted in Germany (das Unfallversicherungsgesetz) and, with certain modifications, in various

Of these the most important by far are those relating to vaccination, since *variola* is extremely prolific of blindness, even in mild cases of the disease. It would be superfluous to mention the various requirements in the several states [1] relating to the vaccination of school children, but it is well worth knowing that, in Connecticut, Maine, and Virginia, laws are in force which require the vaccination of workmen under certain (generally too limited) circumstances.

Maine has the most explicit law on the subject, but restricts its application to paper mills. Thus: [2] "Sec. 83. No owner, agent or superintendent of any paper mill where domestic or foreign rags are used in the manufacture of paper shall hire or admit any person to work in or about said mill who has not been successfully vaccinated or revaccinated within two years, or to the satisfaction of the local board of health.

"Sec. 84. No person shall work in or about any paper mill where rags are used, who has not been successfully vaccinated or revaccinated within two years, or to the satisfaction of the local board of health."

The fine for violation of either of these provisions is restricted to a maximum of fifty dollars. Moreover, there is no minimum limit whatever, and the fines are almost always too light. It is easy enough to see why the employes in and about paper mills should be the especial objects of vaccinial legislation, but, certainly, the law should be extended so as to apply to many other classes of workmen.

Connecticut's law upon the subject is also limited in its application to paper-mill employes. Further, it is altogether too short and unexplicit.[3]

Virginia limits the application of her vaccination statute [4] to "Any

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other lands (England, France, *et al.*) has never been copied, except as to a few of its features, into the laws of the United States or of those of any of the separate States. This law (Unfallversicherungsgesetz) which makes the employer liable at all events, (*i. e.*, irrespective of such questions as contributory negligence, fault of fellow-workmen, assumption of risk, etc.), for accidents to his employes, has had a most excellent effect in the way of preventing injuries to workmen; for, when employers know themselves to be responsible for such injuries at all events they take the utmost pains to prevent the occurrence of accidents. On the other hand, in some of the United States (a nation of extremes) the Workmen's Compensation Act has been a source of oppression to employers.

For an excellent and somewhat copious discussion of this subject, the reader is referred to the series of articles by Dr. W. H. Allport, of Chicago, in the *Illinois Medical Journal*, for Oct., Nov. and Dec., 1909, entitled Studies in Contemporary Workmen's Compensation.

1 Once again, however, nothing at all seems able to "stale" their "infinite variety." A uniform and comprehensive law is badly needed. The right of the various state legislatures to enact compulsory vaccination laws, was upheld in Jacobson *vs.* Massachusetts (197 U. S., 11).

2 *Revised Statutes*, 1903, Chap. 18.

3 *General Statutes*, 1902, Sec. 4693.

4 *Code*, 1904, Sec. 1743e.

person, firm or corporation employing large bodies of laborers in the state of Virginia constructing works of public improvement. . . ."

The laws of the United States and also of the separate states comprise, nevertheless, a rather large number of provisions, the object of which is, at least in part, to prevent the occurrence of injuries to, and diseases of, the eye. Thus, in some states, the shuttles which shoot to and fro in weaving mills must be guarded from flying out of the looms —which, by the way, they sometimes do at all events, often with disastrous consequences to the eyes of those who are working near. Threshing machines, also, are generally required to be so protected that no "joint, knuckle, or jack" thereof, "is dangerously exposed." Persons charging any "hole with nitroglycerin, powder, or other explosive" are usually forbidden to "use any steel or iron tamping bar." Professional shot-firers are quite uniformly required to shoot down the coal in mines "employing" for instance "twenty or more miners to work in the same." The various regulations requiring an adequate supply of outer air in mines, both for breathing purposes and also for the prevention of explosions due to the accumulation of fire-damp, those, also, providing for a sufficient number of adequate escape shafts, for improved safety catches, for "experienced, competent, and sober men" to have "charge of hoisting apparatus and engines"—all these and many similar regulations have a tendency to prevent the occurrence of injuries to the eyes as well as to other portions of the body. Then there are numerous regulations relating to railways, steamboats, steamships, the construction of buildings, etc., which cannot here even be mentioned by title, partly because of lack of space, partly because of the high degree of technicality of many of the matters involved. The necessary laws relating to the manufacture of wood alcohol (a substance productive of often incurable blindness) are yet to be enacted. (See, upon this head, **Wood alcohol**; **Columbian spirits**; **Alcohol, Methyl**; **Methyl alcohol** and **Toxic amblyopia**, in this *Encyclopedia.*)

Before we leave this subject we ought to remind ourselves that all the various laws which tend to shorten the hours of labor, and which limit or prevent the improper employment of women and children in industrial occupations are all—so far as enforced—of a very high degree of value not only in the prevention of diseases and accidents generally, but also of those which, either directly or indirectly, have reference to the eye.[1]

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[1] A nondescript matter of some importance to ophthalmologists may here, though slightly irrelevant, be mentioned, because it belongs still less within the

Passing to the ophthalmo-sanitary regulations prevailing in other countries than our own we first consider the

Ophthalmo-sanitary laws of England.

First of all, there exists in England, as already suggested in a footnote to this article, a Workmen's Compensation Act (1906) by which is placed upon all employers a tremendous pecuniary responsibility for the safety of their men. One effect, among many,[1] of this act, has been to diminish in a most remarkable degree the number of accidents to laboring men in England. The act provides for compensation not only after industrial accidents, but also in case of the development of certain specified industrial diseases, for example miner's nystagmus and bottle-maker's cataract. In addition to this splendid piece of legislation, there exists a "Factories and Workshops Act" (1901) which has also proved beneficial. It prescribes, among other matters, that every factory must be clean, have a certain amount of air-space for employees, provide adequate ventilation, be of proper temperature, and possess adequate and appropriate sanitary accommodation. There are special regulations relating to all persons working in poisonous substances or in conditions dangerous by reason of steam, machinery, fumes, etc.

With regard to vaccination, there is ample provision for this in

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scope of any of the other main divisions of this article. I refer to the drawing of wills for the blind. The fact of the testator's blindness should plainly be noted in what is called the attestation clause—i. e., a brief passage which stands at the close of the will, and which is signed by the witnesses. A proper attestation clause for the will of a blind person, good in any state, is the following: "The foregoing instrument, consisting of......sheet.., was, on this............ day of.............., nineteen hundred and........, *first read over to the testator in our presence, he (or she) being blind, and was then, upon the said date, and forthwith,* signed, sealed, published and declared by the said testator to be his (or her) said last will and testament, in the presence of each of us, the undersigned, who thereupon, at his (or her) request, and in his (or her) presence, and in the presence of each other, have hereunto subscribed our names as the attesting witnesses thereof, the day and year last above written.

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Many attorneys fail to insert the words above italicized. These words, however, are very important to be remembered in the case of a will made by a blind person, for the law does not ordinarily require that a will shall have been read to the testator in the presence of those who are to sign the document as witnesses. Yet, without the words above suggested, or words of similar import, the question of fraud may be raised.

[1] Dr. A. Maitland Ramsey, of Glasgow: "The design of the framers of the Act was, undoubtedly, to minimize the need for legal procedure; but their purpose in this respect has not been achieved, for no statute of recent times has been more provocative of litigation."—"*Eye Injuries*: With Special Reference to the Workmen's Compensation Act, 1906," p. 4; reprint from *The Hospital*, Nov. 13, 20, 1909. This article, by the way, is a valuable contribution to the literature of "Visual economics."

general, but any child can be withheld from what has been called "the terrible torture of vaccination" if its parent, or any responsible person standing *in loco parentis,* avows before a magistrate that he disbelieves in the efficacy of the process. No machinery is provided for revaccination (*per contra* in Germany and especially in Italy).

England was the first of all the nations to provide for medical inspection in the public schools (1872); nevertheless in her system of inspection, even at the present day, there is much to be desired.

The medical inspection of school children is, in England, placed in the hands of the Sanitary Department of the local Government Board, the Board of Education having delegated the work to them. The "machinery" is said to be very defective. There are no requirements at all for admission, but the eyes of all children in "State" schools are tested after entrance. No arrangement has ever been made for treating or retesting.

Some special arrangements have been made for school children who see poorly, but nothing of an adequate nature. It is likely, however, that better arrangements will be made soon.

With respect to *ophthalmia neonatorum* we may say that the use of Credé-drops is not at all compulsory on the part of either medical man or midwife. In case the mother was delivered by a midwife, and any inflammation or discharge appears, the midwife is obliged to report the fact at once to "any qualified medical man," the choice of the particular man being left to her. In England, then, it seems, as in this country, a case of blindness from ophthalmia neonatorum is ever the fault of a midwife. It is somewhat singular that, in the course of my entire practice, which embraced a considerable number of cases of the absolutely unnecessary disease in question, there was not one single case which was not, indisputably, the fault of a regularly graduated physician.

Ophthalmo-sanitary laws in France.

In France, as in England, there exists an excellent Workmen's Compensation Act (that of Feb. 9, 1898), which has been amended and revised until as late as March 31, 1905.

As this law now stands, it provides for indemnity after industrial accidents (*accidents du travail*) no matter to whom the occurrence of such accident is due, excepting only when demonstrably the result from the inexcusable negligence of the injured person himself. This law applies to all industries operating in any way by means of machinery, excepting only such machinery as is run by man- or animal-

power. Further, the work of the injured employe must be interrupted for more than four days.

Twenty-four hundred francs is the maximum earning capacity which is used as a basis for full computation; all overplus is computed at one-fourth. For partial or temporary disability the workman receives one-half the reduction in his wages; for total and permanent disability, a pension equal to two-thirds the amount of his earnings. Pensions are revisable, after three years, the degree of disability being, of course, in many cases subject to change.

In case of the workman's death, 100 francs is paid as funeral expenses. Then, in addition, a pension of 20 per cent. of the wages of the deceased is allowed to the widow, and, to the orphans, 40 per cent. for the loss of one parent and 60 per cent. for both. Dependent relatives, if there be no surviving child or widow, may receive a pension equal to 30 per cent. the wages of the deceased.

Objection has often been made that the law in question has rendered difficult the securing of employment by married persons, especially if these have children. A further objection is sometimes offered that it provides no compensation for disfigurements which do not interfere with the earning capacity. In general, however, the law has been satisfactory (like similar laws in other lands) not merely to employes but also to employers.

In addition to the Workmen's Compensation Act—which has proved so beneficent in the way of preventing injuries of almost every kind—there exist in France numerous laws, or regulations, for the prevention of accidents and diseases. These provide for adequate heating, lighting and ventilation in factories, etc., for cleanliness, for proper water-closet facilities and protection from the action of numerous poisons (lead, methyl alcohol, etc.) and from steam, heated metals, electricity and various sorts of machinery. All these matters are under the control of the Ministry of Labor.

Vaccination is compulsory for all persons, civil and military, and revaccination for the military.

All contagious diseases must, in a manner of speaking, be reported. "Facultatively" reportable[1] are the conjunctivitis purulenta of adults and ophthalmia granulosa. Among the diseases for which are required both reporting and disinfection, is ophthalmia neonatorum.[2]

There is, in France, an excellent system of medical inspection in the public schools. The medical inspector does not, indeed, himself take charge of the treatment of the ailing children, but he is obliged to

[1] Decree of Feb. 10, 1903.
[2] Law of Feb. 15, 1902, art. 4.

report to parents the physical defects of such of their offspring as are attending the public schools; and the parents take the child to some physician of their choice. However, (and this is a point worthy of extensive imitation) the parents are obliged to see that the child is treated, and by some registered physician. The child cannot return to school without the permission (after careful examination) of the medical inspector.

There are no separate schools or classes for trachomatous pupils, the reason, as stated by an eminent French authority,[1] being that trachoma in France is not a sufficiently common disease to render such arrangements necessary. The rule is to permit to remain in the schools all trachomatous pupils exhibiting little or no conjunctival secretion, and to remove all those in whom these secretions are particularly abundant.

The prescription of glasses for school children is looked after, when necessary, and, in some cities, children who see poorly are grouped in special classes. Special schools for children with defective sight are not established, because, it is said, of the distance which children of this sort would then be obliged to go in order to get to school.

The hygiene of the lower schools is controlled by local boards, that of the high schools by the Ministry of Public Instruction.

Midwives are obliged to report at once any discharge or inflammation from the eyes of an infant. The report is made, in Paris and Lyons, to the prefecture of police; elsewhere, to the "maire." The use of Credé-drops is compulosry in all cases, irrespective of discharge or inflammation.

Finally, *"le livret à famille"* hands to all newly married couples a printed card, or circular, containing instructions with regard to the above-mentioned and various other matters.

Ophthalmo-sanitary legislation in Germany.

In Germany, as one might readily suppose, the subject of ophthalmo-sanitary legislation has, in common with sanitary legislation of a general character, received a good deal of attention. It would be impossible to elucidate completely here even the more salient matters of this kind of legal enactments in Germany, but a few of the more peculiar (and, at the same time, I think, sensible and scientific) features may simply be pointed out, practically unaccompanied by comment.

The Prussian sanitary corps is organized as follows: Each county

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[1] Chevallereau, in *Encylopédie français d'ophtalmologie,* Paris, 1910, Vol. IX, p. 545.

(Kreis) has its Kreisarzt,[1] or official physician, for the county. Next each province has its "*Provinzial-Medizinal-Collegium,*" or Provincial Medical College. Over this is the "*Wissenschaftliche Deputation,*" the highest consulting body of the corps. This last-named body, however, is a branch of the "*Abteilung für die Medizinalangelegenheiten*"—itself a branch of the ministry "*der geistlichen Unterrichts-und Medicinal-Angelegenheiten.*" In addition to all these there exists in certain cities "*Gerichtsärzte,*" or "Physicians before the Courts," who are often called upon as experts by the State's Attorney.

Taken altogether, the medical corps is, in Prussia, a many-ranked hierarchy. Its work, however, I understand, is very thoroughly carried out.

Vaccination, to begin with one of the most important matters, is absolutely compulsory in the first year of life, and re-vaccination in the twelfth.

Trachoma, diphtheria, small-pox (the little there is to be found of this last-mentioned disease) must be reported to the police on official cards throughout Germany. There is also a Prussian law [2] which, during epidemics, renders obligatory the treatment of certain diseases, among which trachoma is here especially noteworthy.

The use of Crédé-drops is nowhere compulsory, but a peculiar feature of the law relating to *ophthalmia neonatorum* (characteristically German, too, though a similar practice now prevails in France) is that in many of the cities, notably Berlin, printed instructions concerning the matters in question are handed over to newly married couples.[3] In some of the cities the printed card is not handed over until the first birth is reported—when, of course, it could do no good in the way of prophylaxis, unless indeed as to the eyes of later-born children.

The medical inspection of the public schools is very different in different localities. All the larger and many of the smaller towns employ "school-doctors" not only for the public, but also for some of the private schools—gymnasiums, etc. In Berlin there are 56 school-doctors, each controlling about 5,000 children.[4] All children are tested when they enter, and at intervals, later. Whenever the

[1] The classic work on the functions of the Kreisarzt is Schlockow, "*Der Kreisarzt.*" In general, these functions are to supervise all public sanitary institutions, asylums, etc., also the registers of physicians, pharmacists, midwives, etc. Their court-work is restricted to certain police-evidence.

[2] That of Aug. 28, 1905.

[3] One can hardly conceive of such highly sensible, albeit blush-producing, measures being adopted in the land of the free and home of the brave and often unnecessarily blind.

[4] I am credibly informed that each of these "school-doctors" in Berlin is paid, for looking after his 5,000 youngsters, only 2,000M. annually—less than 500 dollars!

necessity exists, the children are sent to public or private dispensaries. When the parents are poor, the children's glasses are paid for by the city.

Children with defective vision are put into extra classes—the so-called "*Nebenklassen.*" The results of this arrangement are exceedingly satisfactory. However, the vision must be less than 1/10, which is a slight drawback. Other children are, as with us, turned over to the blind-schools. The treatment of the children is compulsory on the parents. A doctor treating a case of trachoma must, as above-mentioned with regard to trachoma in general, report the case to the police on an official card.[1] The police re-report the matter to the Kreisarzt, and this latter functionary sees that the patient takes his treatment and that the doctor's various instructions are acually carried out.

Indirectly tending toward the prevention of injuries to, and diseases of, the eye, is the excellent *Unfallversicherungsgesetz,* which, as already mentioned, has been so widely copied in the legislation of other lands. It would be impossible here, owing to limits of space, even to sketch in outline this very thorough and far-reaching law; we may, however, direct attention to a few, only, of the most characteristic features.

The law provides, then, in effect, for the insurance of all, or nearly all, workmen by their employers. The system consists of two divisions—the federal, and the state. The federal division is organized as a department of the Bureau of the Interior. The state divisions are organized as bureaus of insurance in each of the Bundesstaaten. The state bureaus control the industries within the state, and the federal bureau those of a national, or interstate, character. Every bureau—the federal bureau, as well as the different state bureaus—"collects statistics, makes rules, and constructs reports, and serves as a court of final appeal." Subordinate to the various bureaus are the "Courts for Industrial Claims," the personnel of which consists of one government official (President) and two representatives each, from the employers and the workmen. These courts appoint medical examiners who make reports and who also testify before the court, if there be necessity therefor. The parties themselves may choose the expert, if they so desire. There is no jury.

The fund from which the claims are paid is held by trustees, and is composed chiefly of assessments paid into the fund at stated intervals by the various employers of the nation, grouped into definite units.

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[1] Teutonically thorough is the requirement that complications, origin, nativity, and many other matters must be stated on the card.

The various awards, pensions, expenses, etc., are paid through the Post-Office Savings Bank, and there is no such thing as a judgment being worthless by reason of insolvency on the part of any individual employer.

There also exists, by virtue of this same law, insurance against sickness, old age, invalidism and the first thirteen weeks of disability resulting from accident. The benefits, however, of this "Sickness Insurance Fund" are available only to manual laborers earning not to exceed 2,000 marks yearly.

In addition to this Workmen's Compensation Law—which has had the effect of causing employers to take the utmost possible precautions against accidents—there exist the regulations of the various unions (Berufsgenossenschaften), which regulations are nailed upon the walls of factories, mines, etc. Infraction of these rules is fined heavily—as high indeed as to 1,000 marks.

Ophthalmo-sanitary legislation in Italy.

In Italy the legislation for the prevention of ophthalmic, and other, injuries or diseases, is not so thoroughgoing, quite, as it is in Germany. Yet, in many respects, it is better than similar legislation in the United States.

The sanitary organization is very good indeed—complete and yet not cumbersome. The actual supervision of the public health is delegated to Communal Physicians (Official Sanitarians) while, over these, are the Physicians of the Province, who, in turn, are subordinate to the General Bureau of Health, which forms a part of the Ministry of the Interior. There exist also Provincial Sanitary Councils and a Superior Council of Health.

Vaccination is obligatory for all children in the first six months of life. It must be repeated whenever the sanitary authority deems a repetition necessary. Admission to schools, factories, and various classes of institutions is absolutely barred, except to persons who have been properly vaccinated.[1]

All persons taking up their domicile in the Commune of Milan (and the same regulation exists in certain other communes) must submit at once to vaccination unless indeed he has been successfully vaccinated within six years.

Among other diseases which have to be reported are the following, important from an ophthalmic viewpoint: Trachoma, diphtheria,

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[1] Regolamento sulla vaccinazione 29 marzo 1892 ed art. 130 della legge sanitoria 1 agosto 1907.

small-pox, typhoid fever, and syphilis when that disease has been communicated by ''mercenary intercourse.'' There are no formal official cards, however, providing for a large amount of detailed information, such as are used in Germany. The sanitarian is simply required to report ''the necessary indications.'' Trachoma, furthermore, does not have to be reported. It is only fair to add, though, that the sanitary authority can, when he believes it to be necessary, render the reporting of this disease obligatory. And that has now and then been done, when a severe and wide-spread epidemic of trachoma had appeared.

In the regulations concerning rosiculture, trachoma is regarded as a reportable disease.[1] The patient is always isolated. In this kind of cultivation, I am informed, there is a great foregathering of workmen from very many places.

Midwives are not obliged by law to report ''any redness or inflammation of the eyes,'' but, as a rule, they do actually report these matters (in accordance with certain instructions issued to all who practise midwifery) to physicians, and then the physicians are obliged to make a report of the case. Midwives are also instructed to wash the lids and inward parts of the eyes of all newly-born children with boric acid lotion, and then, if, in spite of these precautions, an inflammation develops, to report the matter, as above stated, to some qualified physician.

No printed cards relative to ophthalmia neonatorum are handed over to newly-married couples, as is done in France and Germany.

No certificates relative to the sight are required for admission to the schools. All the communes, however, have their schools inspected medically at least once per month, thus, in the matter of frequency, setting a splendid example to nearly all civilized lands. If contagious diseases are discovered, all the afflicted pupils are removed until such time as the reappearance of such pupils can be made in the schools with perfect safety to other students. The matter is chiefly left to local supervision, but the governmental sanitary authority also has the power to carry out the inspection himself.

In some of the communes oculists, as well as general practitioners, are employed to inspect. In general, however, the law pays little attention to matters of sight, but lays most stress on the subject of contagion. Very much is left, in every jurisdiction, to the discretion of the teacher and the visiting physician.

There are no separate classes for children with defective sight. Sep-

[1] Art. 13 del Reg. 29 marzo 1908.

arate schools (or classes) however, exist in the larger communes for children afflicted with trachoma.

The excellent German *Unfallversicherung*, already adverted to in this article a number of times, has stood as a model for similar legislation in Italy, as in so many other countries. This insurance law has special application in Italy to industries in which machinery is used, and in which the number of workmen employed exceeds five. Crews of ships are also insured. Agricultural laborers are not insured, excepting those occupied in the use of machinery. The law, I understand, ''works well and is severely applied.'' It has also ''prevented hosts of accidents.''

In addition to this very beneficent compulsory insurance law, there exist in Italy numerous regulations for the prevention of mischances in various sorts of industries. A discussion of these would lead us far afield. Suffice it to say that, in Italy, almost every form of injury by machinery, explosive substances, poisons, etc., etc., has been brought within the prevision of the law.

IV.

MALPRACTICE.

Surgery means snags, and he that does much surgery will sooner or later discover himself entangled in snags of a legal kind. To this rule the surgery of the eye is by no means an exception; it is, in fact, rather an exaggerated instance of the working of that rule. The largest proportion of malpractice suits, to be sure, grows out of fractures and dislocations,[1] while obstetrics as a fruitful field for damage suits comes clearly next in order, but then, as class three, and close to the two preceding categories, comes the surgery of the eye.

The reasons for this high degree of liability in the case of ophthalmic surgery are exceedingly numerous. Suffice it to state three: (a) The delicacy and great importance of the organ on which such surgery is done. (b) The rather large amount of surgery which is necessary in connection with the treatment of diseases of the eye. (c) The special responsibility imposed by the law (at least in the United States and England) upon any one who professes to be a specialist.

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1 This, at least, is true in the United States. In Germany, I understand, malpractice suits arise most often from obstetrical procedures. See, for example, Gottschalk, ''*Gerichtliche Medicin*,'' p. 271: ''Von den Anklagen wegen Kunstfehler nehmen aber an Zahl die erste Stelle ein diejenigen gegen Geburtshelfer.'' The statement accords with the generally received opinion that deformity of the female pelvis is commoner by far in Germany than in the United States.

In the discussion of the subject of ophthalmo-surgical malpractice, precedence will be given—as was done in the case of the ophthalmic expert witness—to

A.—Legal considerations regarding malpractice.

Legal considerations regarding malpractice in the United States. In the United States—as indeed in almost, but not quite, every civilized country—this one basic proposition underlies the entire law of malpractice, namely, that a physician is never legally required to respond to a call for professional assistance, if (a) he is not a governmental officer and thereby under official obligations, or if (b) he has not already established relations with the case. This is precisely to the contrary of the popular impression, but is nevertheless the law. Says Wharton:[1] "No question can exist as to the legal right of a physician, unless he be an officer of the government charged with specific duties, which he thereby violates, to decline to take charge of a particular case." A recent Indiana case[2] well illustrates precisely how free a physician is to refuse to take charge of a case. Here the physician, who had been the patient's family practitioner, refused, admittedly without reason, to respond to the call of a man who was intensely sick, although he (the doctor) had confessedly been tendered the fees for his services in advance, and although he knew that no other physician could possibly be procured in time to be of service to the patient, and that, if he (the physician in question) did not respond, the patient would probably die in consequence. The sick man did actually die, and, as alleged, in consequence of the physician's non-response to his call. There could hardly have been a stronger case against the physician, were the law other than it really is. But said the court: "The act is a preventative, not a compulsive, measure. In obtaining the state's license (permission) to practice medicine, the state does not require, and the licensee does not engage, that he will practice at all or on other terms than he may choose to accept. Counsel's analogies, drawn from the obligations to the public on the part of innkeepers, common carriers, and the like, are beside the mark."

When, however, a physician once takes charge of a case, certain responsibilities attach to his work immediately and by implication. No express agreement to be responsible for this or that is at all necessary in order to render him responsible. On the other hand, with one exception, he cannot evade his professional liabilities by any sort of

[1] *On Negligence,* Sec. 731.
[2] Hurley Admr. *vs.* Eddingfield, 156 Ind., 416.

contract whatever, however express and however explicit. Contracts made in advance of treatment or operation, with a patient, or with a patient's parent or guardian, that the physician is not to be sued for malpractice, are universally held to be "opposed to public policy" and therefore void.[1] The one exception is where a physician declares to the patient his inability to treat the case properly (as, for instance, in many instances, where a specialist is recommended) and yet the patient insists that the physician proceed to do the best he can. In such circumstances the patient is estopped from complaining afterward that the case has not been treated properly—provided, of course, the physician has really done the best he could.

On the other hand, although, as we have seen, the physician cannot, generally speaking, diminish, either in number or extent, the liabilities which the law imposes on him, he can very easily (and often to his sorrow) very greatly enlarge them. And he can also lessen his rights, as well as increase his liabilities. A very common instance of lessening his rights results from the "no cure no pay" agreement. In this instance, if the patient is not cured he does not have to pay; the physician has lost his right of action against him for the fees. An instance where the physician voluntarily enlarges his liabilities results from the "guaranty to cure." This highly important arrangement is a very different affair from the "no cure no pay" agreement, though, as a rule, physicians confound the two together. When a physician guarantees to cure, he must cure, or "pay the difference." That is a very different consequence, as will at once be noted, from merely losing one's fees. To illustrate: If a physician operates for cataract, and guarantees to restore to the operated eye its vision, then, if the sight be not restored, the measure of the damages is precisely what the sight of that eye would have been worth. A jury may assess this value at thousands of dollars.[2]

Now, what are these responsibilities that attach to a physician immediately upon his acceptance of a case, and by implication irrespective of any express contract? They are:

1. Properly to continue his attendance.
2. To possess a reasonable degree of learning and skill.

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[1] Nor does treating a case gratuitously at all diminish the physician's liability for malpractice.

[2] It is a general rule of contract that, when a party has, for a consideration, agreed to deliver a certain article—whether iron rails or eye-sight—and has failed to deliver it, he must pay to the injured party the value of the article in its stead. Returning the compensation may, in the case of some contracts, be precisely equivalent to payment of the value of the article, but (as in the case of failure to restore to a cataractous eye its sight) it may fall short of so doing by several thousand dollars.

3. To use that reasonable degree of learning and skill.
4. In cases of doubt, to use his best judgment.

Of each of these duties, we will treat in the order indicated, and, later, of certain miscellaneous affairs of importance in connection with malpractice.

1. As to the physician's duty properly to continue attendance, we may say, briefly, that, in no instance, may he discontinue his treatment, unless (a) the patient discharges him, (b) the patient consents to the discontinuance, (c) the physician gives timely notice so that the patient may employ another doctor in due season, (d) when the patient is no longer in need of the physician's services.

2. The physician's second duty, when he has once taken charge of a case, is to possess a reasonable degree of learning and skill. Of course a physician is not responsible merely for failure to cure. He is responsible only for the failure to possess (or to use) a reasonable degree of learning and skill. The question unavoidably arises, What constitutes a reasonable degree of skill and learning? In the United States, there exists on this important head three very different rules:

a. The physician is bound to exercise that degree of care and skill which prevails in *the particular locality* in which the given case arises.[1] This rule is not much followed.

b. The physician is bound to exercise that degree of care and skill possessed by physicians in *such localities generally*.[2] In this case, the court said, speaking with regard to the first of the rules on this subject, namely, the "particular locality" rule: "There might be but few practising in the particular locality, all of whom might be quacks, ignorant pretenders to knowledge not possessed by them, and it would not do to say, that, because one possessed and exercised as much skill as the others, he could not be chargeable with the want of reasonable skill." According to this second, or "similar localities" rule, the physician practising in a large city is bound to possess a higher degree of skill and knowledge than physicians who practise in the smaller cities and those in the smaller cities than those who practise in the villages and the country. The second rule is the prevalent rule, by far.

A most excellent, as well as recent, case upon this second, or general, rule, is that of Shelton *v.* Hacelip (51 So. Rep. 937, May 7, 1910, Ala.). In this case, a child, 11 months of age, Velma Hacelip, "had been affected with chicken-pox and nausea, and the right eye (the one destroyed) was inflamed, ulcerated in the external corner, had scabs

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1 Hathorn v. Richmond, 48 Vt. 557.
2 Gramm v. Boener, 56 Ind. 497. McDonald v. Harris, 131 Ala. 359.

on it, and was infected with pus and 'septic poison.' " The further facts (all undisputed) were: "That defendant was called professionally to see her, mainly, it appears, for the eruption and nausea. That he examined the right eye, and stated that he would give a prescription for its treatment, and at the same time instructed the parents to keep the organ clean with the frequent application of warm boiled water. That what was received as this prescription was used by dropping three or four drops, from a teaspoon, into the eye after lifting the eyelid. That this application was made in the afternoon about two o'clock. That the child at once gave evidence of being in great pain in that eye, and, with its hands, rubbed off the scabs, and introduced the poisoning pus into the eye. That the sight of the eye was destroyed when examined on the succeeding morning, the destruction being accomplished by the thickening of the tissues over the sight of the eye."

The court first quoted the rule as given in McDonald v. Harris (131 *Ala.* 359) as follows: "The reasonable and ordinary care, skill, and diligence which the law requires of physicians and surgeons is such as physicians and surgeons in the same general neighborhood, in the same general line of practice, ordinarily have and exercise in a like case." The opinion of the court was then as follows: "The evident theory of the plaintiff (appellee) was on the trial that the liquid introduced into the eye contained carbolic acid, and that the destruction of the sight resulted from that. It is obvious that, if the loss of sight was due to disease, the defendant did not breach his duty, unless in the treatment thereof he failed to measure up to the standard stated before; and it is equally as obvious that the plaintiff's theory excludes any other means or omission leading to that breach of duty in the premises except that rested on the use of carbolic acid (a matter disputed in the proof) in the prescription written by the defendant in the treatment of the eye. Dr. Hughes and defendant both testified that the prescription written by defendant was prepared by Hughes, and not by defendant, and that in it there was no ingredient of carbolic acid. Dr. Murray testified that the eye nor lid nor face gave any evidence of having been burned with carbolic acid, and that in his opinion the loss of sight was due to the disease. There are some tendencies in the evidence to the effect that the preparation contained carbolic acid, the chief of which were afforded by the testimony of two witnesses that the contents of the bottle bore an odor of carbolic acid, and that the sediment in the bottom of the bottle was similar to that made by an excess over a solution of carbolic acid.

"The burden of proof in cases of this character is on the plaintiff to

show that the defendant's care, skill, or diligence in the given case was not that required, as stated, of physicians and surgeons; and it should be added that there is no presumption of negligence or want of skill arising from the failure to cure. (30 *Cyc.* p. 1584, and authorities in notes.) It is evident from this record that the controlling issue was whether the preparation applied to the eye was that prescribed by the defendant. As indicated, there was some evidence tending to show that the preparation was that prescribed by the defendant, and that it contained carbolic acid. It consisted of the testimony of Mrs. Daniel that the defendant brought the bottle to the house where the child was, and that out of this bottle the liquid was put into the eye. It must be conceded that there was a conflict in respect of the issue stated. In the light of all of the evidence, however, the opinion is entertained that the weight of the evidence and the probabilities of the truth of that tending to fix liability upon the defendant are so strongly against the verdict as to carry conviction that it is wrong and unjust.

"In the first place, the long period of time elapsing between the injury and the institution of the action, in connection with the undisputed fact that defendant was subsequently often called professionally to treat members of Mrs. Daniel's family, are circumstances impossible to be ignored in determining the weight to be given Mrs. Daniel's, the next friend's, testimony. In the second place, Dr. Sullivan's testimony may be taken at the limit of its probative value, and yet, when boiled down, it amounts to nothing more than that the injury "might"—a term, as employed, no stronger than possibly—have been produced by carbolic acid, or "might" (i. e., possibly) have resulted from a virulent form of conjunctivitis, a disease of the membrane of the eyeball. There was for the plaintiff no evidence that the eyeball or its membranes were burned by a caustic; carbolic acid being of that class of chemicals. On the contrary, the proof is conclusive that carbolic acid, when applied to the human anatomy—its component membranes—deadens, and the inevitable effect is to produce a sloughing of the cauterized part. There is a total absence of proof that any sloughing occurred. As we view the evidence here, it is impossible to cauterize a membrane with carbolic acid, and affect only to change its color. It is incredible on this evidence that the iris could be altered in color from brown to white by the application of carbolic acid, and at the same time avoid sloughing of the cauterized membrane. Directly opposed to the plaintiff's theory of fact there is the testimony of Hughes and defendant and that of Dr. Murray, and the original prescription defendant contends was supplied by him. The

two first mentioned say that there was no carbolic acid in the preparation, and that the prescription was filled by Hughes, and not by the defendant. The original prescription is before us. Carbolic acid is not one of its named elements. Dr. Murray saw the eye the next day, and he is positive that there was no evidence of cauterization about the eye or face. So far as appears, he is without interest in the premises. He was called by Mrs. Daniel. Support for the plaintiff's insistence must come from the odor and the sediment. Two witnesses say there was an odor of carbolic acid, and one that there was a cloudy sediment in the bottle. The inevitable effect of carbolic acid on membranes and the positive statement of Dr. Murray that there was no cauterization, and that there was no sloughing and the testimony of Hughes and defendant, all in connection with the long lapse of time between the injury and the commencement of the action and the continuance of defendant in the professional service of the household, compel the conclusion that carbolic acid did not destroy the child's sight.

"The court should have granted the new trial. Its refusal was error, and on that account the judgment must be reversed."

c. Some of the lower courts have attempted to establish a yet higher standard of professional knowledge and skill, a standard which has been expressed in the following language: "Such skill and diligence as are ordinarily exercised by *thoroughly educated physicians and surgeons.*" No court of last resort, however, in the United States, has yet sustained this rule.[1] However, the tendency is, with the continued improvement in medical education, for the courts to approximate more and more closely to this very high standard of medical and surgical requirements.

Now, all these three rules (the second, as before stated, being the prevailing one) apply to general practitioners only. A question of especial interest of course arises here: What is the standard of requirement in the case of specialists, ophthalmic surgeons, for instance?

It is undoubtedly a fact that a specialist (and, in this connection, a specialist is any one who holds himself out, in effect, to be such) is bound to a higher degree of skill than is a general practitioner. The rule is that a person assuming to be a specialist must really possess and actually use the ordinary learning and skill possessed and used

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[1] Unless we except the Supreme Court of Pennsylvania in McCandless v. McWha (22 *Pa. St.* 26). In this case Woodward, J., defined "reasonable skill and diligence" to be "such as thoroughly educated surgeons ordinarily employ." It is a question, however, whether this definition is not merely *obiter*. Further, the case is by no means recent; its date is 1853.

by others who practise the same specialty or specialties in similar localities. Even in the case of a specialist, however, practising in a city of the very largest class, the degree of skill required is by no means such as would enable him to effect a cure in every case that comes before him. There is, in other words, on the part of the specialist no implied warranty to cure any more than there is in the case of the general practitioner. A warranty to cure can arise only from an express contract—a contract which, however, as everybody knows, even with all its possible disastrous legal consequences, certain physicians are nevertheless unwise enough to enter into. The law does not attach legal consequences, either to general practitioner or to specialist, merely for failure to cure. It is to malpractice—the failure either to possess, or to use, the proper degree of knowledge and skill (which varies according to locality, specialism, etc.) that the law attaches such consequences. The leg or the arm, or the ear or the eye, must have been improperly treated or in some way neglected, in order to constitute malpractice.[1]

The effect of this principle is very far reaching. In Stern v. Lanng,[2] for instance, Dr. Lanng, an oculist, had removed a chalazion from the left lower eyelid. He had made on the conjunctival surface of the lid a crucial incision down into the cyst, and, after removing the gelatinous contents of the growth, had used a tiny scoop for the removal of the sac. Finally, he had cauterized the cavity by means of a stick of nitrate of silver "about an inch in length" and "about the shape of a lead pencil." The eye itself became much inflamed, and solutions of atropin and boric acid were employed to combat the inflammation and for disinfecting. The lid became adherent to the cornea, and the cornea became opaque. In consequence of the corneal opacity the eye was entirely blind. At the trial three expert oculists pronounced the treatment proper. Said the judge in the higher court: "The inflammation of the cornea, and consequent opaqueness, is ascribed by the appellant to the cauterization of which he complains, but this is not sustained by the testimony. There are, we are informed, a number of causes for it, and that it is impossible to look at the eye and tell whether it has been burnt or not . . . The result of the treatment is not all that is necessary to recover. It must be made evident that there was negligence or want of skill. There was intense pain felt by plaintiff after the incision. It does not necessarily

[1] And, need we add, damage of some sort must actually have followed from such unskilfulness or negligence, in order to entitle the patient to recover. Otherwise, it is *injuria absque damno,* wrong without damage, and this is not actionable.

[2] 106 *La.* 736.

follow, as we infer, that it was owing to the negligence or unskillfulness of the physician.'' The judgment which the defendant had obtained below was therefore affirmed.

Another leading eye case on this point is that of Pettigrew v. Lewis et al.[1] The plaintiff, a school teacher, alleged that an operation had been performed on her left eye by the defendants (partners) for strabismus, and that the operation had been performed so negligently and unskillfully ''that her eye became sore and weak, rendering her unable to complete her education or to perform ordinary household work.'' She further alleged that she ''suffered and still suffers great physical pain in consequence of the unskillful operation and treatment, which has continued to increase since the time of the operation.'' The lower court, however, sustained a demurrer to the evidence, ''holding that it was insufficient to establish a liability against the defendants . . . and gave judgment accordingly.'' The plaintiff took the case to the Supreme Court, there urging ''that the testimony offered by her was sufficient to take the cause to the jury.'' But said Justice Johnston: ''We agree with the district court that it [the evidence] did not show the operation to have been unskillfully and negligently performed, nor yet that the present condition of her eyes was the result of the operation that was performed. No proof was offered of the instruments used or the manner in which the operation was performed. No medical or scientific evidence was offered showing the cause of the present condition of the plaintiff's eyes, nor that the defendants were negligent or careless in the performance of the operation. In fact no witnesses having special skill or knowledge with reference to the treatment of the eyes were introduced in behalf of the plaintiff. The burden rested on the plaintiff to show a want of due care, skill, and diligence in the operation, and that the defective condition now existing is the result of such want of care, skill, and diligence.''

Now the degree of learning and skill which the specialist does really need to possess and actually to employ in order to escape the legal consequences which the law imposes upon a specialist guilty of malpractice, is, as already stated, such a degree as is ordinarily possessed and actually used by specialists (not general practitioners) practising the same specialty, or specialties, in similar localities.

A couple of illustrations may possibly here be useful. In Feeny v. Spalding[2] the defendant was a distinguished oculist who practised in Portland, Me. While on a trip to Machias he stopped over for a short

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[1] 48 *Kan.* 78.

[2] 89 *Me.* 111. See also Rann v. Twitchell, *Vt.*, 1909; 71 At. 1045; 20 L. R. A. N. S. 1030.

time at Cherryfield. Here a girl, seven years of age, cross-eyed since she was a year and a half old, was brought to him for examination and treatment. After a conference with the parents, defendant performed a surgical operation on one of the plaintiff's eyes. The plaintiff alleged that, prior to the operation, the sight of the eye on which the operation had been preformed, was at least fairly good, but that, after the operation, it was entirely wanting. She further alleged that this result was produced by defendant's ignorance, want of skill, and carelessness in the performance of the operation. The plaintiff, in the trial court, had received a verdict. Said the court: "It was encumbent on her [the plaintiff] to prove that the injury complained of was caused either by the defendant's want of that degree of skill and knowledge which is ordinarily possessed by physicians who devote special attention and study to the treatment of the eye, or by his failure to exercise his best judgment in the application of his skill to the particular case, or by his failure to use ordinary care in the performance of the operation, and in giving such instructions as should have been given by a surgeon who was only to perform the operation, and who was temporarily in the locality where the patient lived . . . At the trial, the plaintiff relied almost entirely upon the result which it is claimed followed the operation . . . while the expert testimony on the part of the defense was to the effect that an examination of the eye showed conclusively that the defective vision had existed from birth and that it was as good at the time of the trial as it ever had been . . . Even if there was sufficient evidence to authorize the jury to find for the plaintiff upon this question, such a finding was not sufficient to warrant a verdict for the plaintiff, when there was no evidence of any want of the requisite skill, knowledge, or care upon the part of the defendant."

Still another case is that of Baker v. Hancock.[1] Here the defendant was a specialist in the treatment of cancer. Plaintiff alleged that defendant had placed upon his nose a substance by "which the end of his nose was eaten off." The verdict below was for the defendant, but the higher court reversed the judgment and remanded the case for a new trial, saying: "Scientific investigation and research have been extended and prosecuted so persistently and learnedly that the person affected by many forms of disease is of necessity compelled to seek the aid of a specialist, in order to secure the results thereof. The local doctor, in many instances, himself suggests and selects the specialist whose learning and industry have given him a knowledge in

[1] 29 *Ind. App.* 456.

the particular line which the general practitioner, in rural communities especially, has neither time nor opportunity to acquire. (Small v. Howard, 128 Mass. 131.) Being employed because of his peculiar learning and skill in the specialty practised by him, it follows that his duty to the patient cannot be measured by the average skill of general practitioners. If he possessed no greater skill in the line of his specialty than the average physician, there would be no reason for his employment; possessing such additional skill, it becomes his duty to give his patient the benefit of it. The appellee, if he held himself out as a specialist in the treatment of cancer, was bound to bring to the discharge of his duty to patients employing him as such specialist that degree of skill and knowledge which is ordinarily possessed by physicians who devote special attention and study to the disease, its diagnosis and treatment, having regard to the present state of scientific knowledge. This is the degree of skill which, by holding himself out as a specialist, he represented himself to have; and it does not lie with him to assert, after securing employment and compensation on that basis, that his representation was not true.''

In any case, however, whether the defendant is city or country general practitioner or city or country specialist, the degree of skill and learning required has reference always to ''the present state of medical and surgical knowledge.'' This legal proposition is illustrated clearly in Peck v. Hutchinson.[1] The plaintiff, as alleged, had had ''infection of conjunctivitis and blennorrhea,'' together with a perforating ulcer of the cornea and prolapse of the iris. Defendant had operated on the eye, and, as alleged, had used ''too large a knife,'' etc., etc. A matter which bulked very largely at the trial was that, in the course of the operation, the plaintiff had suddenly jerked her head about, causing the production of a false incision, deep and long, directly across the cornea. To this unfortunate movement the defendant attributed the non-success of his operation. The plaintiff, in her turn, contended that the movement was unavoidable by reason of the fact that the work had been done under local, instead of general, anesthesia. The plaintiff's counsel was allowed to read from Wells's ''*Treatise on the Eye*'' the remarks by that author on the subject of iridectomy. In the course of these remarks the author states that, for iridectomy, chloroform should always be administered. He does not even men-

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[1] 88 Iowa 320, 55 N. W. Rep. 511 (''N. W. Rep.'' stands for ''*Northwestern Reporter*,'' a convenient periodical, published by a private company, but containing in each issue the latest decisions of the courts of last resort in various northwestern states. It appears sooner, and is often more accessible later, than the official state reports. There is also a ''*Southwestern Reporter*,'' a ''*Southeastern Reporter*,'' etc.).

tion local anesthesia. In accordance with the views of this book, the counsel for the plaintiff declared that the defendant had neglected his duty, inasmuch as he had operated with local anesthesia only. But said the higher court: "The book was published in 1880 . . . the operation was performed in 1886, and it is claimed that, after 1880, and prior to 1886, great changes had occurred in optical surgery; that during that time, cocain, a local anesthesia, was discovered, and came into use, thus superseding the use of general anesthetics in such cases. This may be conceded . . . that fact was fully shown to the jury. 'Physicians and surgeons are required to use ordinary skill and diligence . . . having regard to the improvements and advanced state of the profession at the time of the treatment.' " The judgment, which, in the lower court, had been for the plaintiff, was, therefore, by the higher court reversed.

Here is a still further point in connection with the question of what constitutes a reasonable degree of learning and skill. The matter is always to be tested by the doctrines of one's own school of practice. This legal proposition is absolutely indisputable, having been decided in a very large number of cases, with, so far as I know, not a single dissenting case.[1] The principle is, in fact, not merely good law, but also good sense. So long as the law gives recognition to various so-called "schools," it must, as a natural consequence, allow the treatment of any given physician to be tested by the doctrines of the school he professes to practice. To hold a regular practitioner culpable for ignoring the principles of, say, homeopathy or of eclecticism, or an osteopathic physician for not proceeding according to the principles of regular medicine or of homeopathy, would be, in effect, not merely to violate the compact made with the State when the physician was granted a license to practise, but also to break the contract made by implication between the patient and the practitioner when the latter was employed in the case.

The rule, however, does not apply to the case of a clairvoyant or of any other person who practises a system which has no recognition under the law and nothing definite in the way of rules and principles. Thus, in Nelson v. Harrington,[2] said Lyon, J.: "To constitute a school of medicine under this rule, it must have rules and principles of practice for the guidance of all its members, as respects principles, diagnosis, and remedies, which each member is supposed to observe in any given case. Thus, any competent practitioner of any given

[1] This rule, however, has never been adopted, at least so far as I have been able to ascertain, in any of the countries of Continental Europe.

[2] 72 *Wis.* 591. Cited also *supra*, under another legal proposition.

school would treat a given case substantially the same as any other competent practitioner of the same school would treat it. One school may believe in the potency of drugs and blood-letting, and another may believe in the principle *similia similibus curantur;* still others may believe in the potency of water, or of roots and herbs; yet each school has its own peculiar principles and rules for the government of its practitioners in the treatment of diseases. Not so, however, with the clairvoyant practice. True, the practice has but one mode of ascertaining what the disease is, and the remedy therefor. This mode has already been stated. But the mode in which a physician acquires a knowledge of his profession has nothing to do with his school or system of practice. One person may acquire such knowledge from certain books; another from certain other books, which perhaps teach different principles; still another from oral communication, as lectures, et cet., or from experience alone; and still another from his intuition when in an abnormal mental state; yet these differences do not necessarily constitute separate schools of medicine."

This was "a case of first impression," (as mentioned by the learned justice himself in his opinion) but it is now the settled law.

3. Now it is, furthermore, absolutely necessary that a doctor, whether his field of work be limited or unlimited, and whether his practice be chiefly in the city, or in a town, or in the smallest country village, not merely possess, but that he also actually make use of the skill and learning which the law requires him to possess in accordance with the rules above stated. He must not be negligent, however skillful he may be. He must actually exercise his skill. Otherwise he is guilty of malpractice.

It is not essential that this division of the general subject be greatly amplified, but here it is certainly important to lay some stress on a matter which should prove of interest to oculists, who, as a rule, do rather a great deal of innovating. I refer to the matter of experimentation. On this head, the general principle is quite clear: Thou shalt not experiment on mankind. The use of new and untried remedies or new and untried operative procedures, are alike forbidden, in the case of man. The view of the law is that experimentation should be conducted on the lower animals. Just what would happen to medical progress in case our friends, the antivivisectionists, should carry their point, and experimentation on animals should be forbidden also, as well as that on man, is a trifle unpleasant to think about. Possibly, in the words of Micawber, we should "progress in a retrograde direction." However, the matter is not so bad as it looks in the light of the general rule. There is one exception: The doctor may in-

novate in the case of an unusual disease (pellagra, for example) or of new and unusual combinations of symptoms in old diseases. Even in such cases, however, he must be altogether able and ready to prove that his innovations were not haphazard, but that they were based on things already known and that they were carried out in accordance with a definite and sensible theory of some benefit to accrue to the subject of the experiment himself.[1] Said the court, in Jackson v. Burnham:[2] "There must be some criterion by which to test the proper mode of treatment in a given case; and, when a particular mode of treatment is upheld by a consensus of opinion among the members of the profession, it should be followed *by the ordinary practitioner;*[3] and if a physician sees fit to experiment with some other mode, he should do so at his peril. In other words, he must be able, in the case of deleterious results, to satisfy the jury that he had reason for the faith that was in him, and justify his experiment by some reasonable theory." Again, in Carpenter v. Blake,[4] said the court: "Some standard by which to determine the propriety of treatment must be adopted; otherwise experiment will take the place of skill, and the reckless experimentalist, the place of the educated, experienced practitioner. If the case is a new one, the plaintiff must trust to the skill and experience of the surgeon he calls; so must he if the injury or the disease is attended with injury to other parts, or other diseases have developed themselves, for which there is no established mode of treatment. But when the case is one as to which a system of treatment has been followed for a long time, there should be no departure from it, unless the surgeon who does it is prepared to take the risk of establishing, by his success, the propriety and safety of his experiment."

Of course the great defect of the law with regard to the matter of experimentation and innovation (medically speaking—we admit that the subject is difficult) lies in this one point, namely: That it makes no kind of provision whatever for the finding out of new and more perfect methods of treatment in old and well-known diseases presenting old and well-known combinations of symptoms. For instance, an oculist desires

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1 In this connection the words of Aristotle with reference to the Ancient Egyptian law, are interesting: "Even in Egypt the physician was allowed to alter the mode of cure which the law prescribed to him, after the fourth day. But if he did so sooner, he acted at his own peril."—*Politics,* Book III, c. 15.

2 20 *Col.* 533.

3 These words (which have been italicized by the present writer) are, though *obiter dictum,* extremely interesting. They suggest this question: Have some practitioners a better right to experiment on human subjects than have others?—a question which, so far as I have been able to ascertain, has never appeared for direct decision in any court of last resort.

4 60 Barb. 488. ("Barb." is short for "Barber." The Barber reports are certain N. Y. reports which bear the name of their reporter.)

to ascertain whether the injection of certain substances into the anterior chamber of the eye will result in the complete absorption of a senile cataract. Now, senile cataract is by no means a ''new'' disease, but perhaps older than the human race itself, and, furthermore, for this condition there exists a well-established line of operative treatment. Yet, to forbid the innovator from trying his injection (with or without previous animal experimentation, according to his judgment) would, beyond question, be to hinder the onward march of medicine. Even though the results of the experiment should be unfavorable to the individual, something might very conceivably have been ascertained that would prove immensely serviceable, indirectly at least, in many an after case. Of course, there should be a reasonable chance that the innovation would prove to be an improvement, even for the subject of the experiment himself, over methods long established. Perhaps the *dictum* in the Colorado case with reference to ''ordinary'' doctors, might help out, should an innovator in the case of an ''old'' disease, presenting nothing but old and well-known combinations of symptoms, get into legal difficulties by reason of his experimentation.[1]

Other matters coming under the head of negligence, or failure actually to use and employ the reasonable skill and knowledge which the law requires a physician to possess, may thus be stated briefly: A physician is liable for giving improper directions and for failure to give proper ones. He is also liable for failure to call counsel in proper cases. He is just as truly liable for an improper opinion (if damages ensue therefrom) as he is in the case of actual treatment given. He is bound to use pure and proper drugs and aseptic instruments, and to write correct prescriptions. A physician is liable for the malpractice of his partner, though he himself had nothing to do with the case. He is also responsible for the acts of a nurse, if the nurse was acting according to his instructions; and, further, even in other instances, if the nurse was placed in charge of the case by the physician in question who thus by implication warranted her skill and carefulness. A physician is not, however, liable for the acts of a nurse in a public institution in which the physician himself has no direct control over the nurses. A physician is not responsible for the malpractice of a phy-

[1] The leading case on this subject is the Colorado case above mentioned, Jackson v. Burnham. Here the plaintiff had had severe phimosis, and the defendant, instead of slitting up the prepuce, had applied to the penis a flaxseed-meal poultice. Gangrene ensued, together with extensive sloughing, and it became necessary to amputate ''his penis wholly from the body.'' The district court gave judgment to the plaintiff. This judgment was reversed by the Court of Appeals, but sustained by the court of last resort (Supreme Court). Here, however, the innovation was clearly not founded on things already known or on a definite and well-formed theory of benefit to accrue to the subject of the experiment himself.

sician in whose charge he leaves a case, provided the two are in independent practice (i. e., not in partnership) or of a specialist in independent practice to whom the case has been referred by him.

Sometimes the patient himself is negligent, and, under certain circumstances, this "contributory negligence," as it is called, is a complete defense against a claim for malpractice. However, if the acts of the patient did not produce the injury, but merely aggravated it, they are not a complete defense, but may be shown only "in mitigation of damages"—i. e., to diminish the amount of the judgment. An important principle is that, if the injury produced by the patient's negligence cannot be separated from that produced by the negligence of the physician, the patient cannot recover damages.

Some of the commonest forms of contributory negligence consist in (a) failure to follow the physician's directions (b) not giving to the physician full information with respect to the case, (c) the simultaneous employment by the patient or his friends of other treatment in connection with that of the regular physician.[1]

4. The fourth duty of the physician is, in cases of doubt to use his best judgment. This is a difficult rule to understand, because its meaning is indefinite. Nevertheless, the rule exists, and is exceedingly important. The conception is that a physician, though possessed of a reasonable degree of learning and skill and though exercising care in its application, is now and then confronted by peculiar conditions in which he must use his own individual judgment instead of relying on the common stock of knowledge. Whether, in such conditions, it is actually incumbent on the physician to experiment, is a question which, so far as I have been able to ascertain, has never been decided. Probably, should the question arise, it would be decided in the negative. However, it is likely that an actual case or two will do the utmost possible service in the way of making clear this very difficult rule.

In a rather early case, West v. Martin,[2] the defendant was sued for unskilfullness in the setting of the plaintiff's leg. The defendant, among other matters, pleaded "mere error of judgment." But said Ewing, J., in the Supreme Court: ". . . there may be responsi-

[1] A discussion of this matter would lead us into the never-ending realm of medical folklore. I cannot, however, refrain from mentioning a case in which I was much blamed because, after an entropium operation performed by me, erysipelas supervened. On inquiry, I learned from the patient himself that his mother had twice removed the dressings and applied each time for several hours a poultice of warm cow's dung. I also knew of a case where tetanus set in following the application of road mud to a burn. Without doubt, if proper investigation were made in all cases of malpractice, the matter of folk-medicine would assume a more important aspect in connection with the subject of malpractice defence.

[2] 31 *Mo.* 375 (1861).

bility where there is no neglect, if the error of judgment be so gross as to be inconsistent with the use of that degree of skill that it is the duty of every surgeon to bring to the treatment of a case according to the standard indicated.''

In Dubois v. Decker,[1] the plaintiff, having a crushed foot, was taken to an almshouse, in which institution, some nine or ten days later, the defendant amputated the leg above the ankle joint. ''Six or seven days thereafter, gangrene having set in, he again amputated the leg, this time at the knee-joint. After the second amputation the leg did not properly heal, but became a running sore, and at the time of the trial the bone protruded some three or four inches.'' The position taken by the plaintiff was that the second amputation had been necessitated, and the deleterious results which followed it had been caused by the delay of nine or ten days in the performance of the first operation. There was expert evidence to show that this was really the case. The defendant alleged ''mere error of judgment,'' stating that he had ''waited ten days before operating for the purpose of seeing whether the foot could not be saved, and that a physician and surgeon will not be held liable for mere errors in judgment.'' But said Justice Haight: ''. . . his judgment must be founded upon his intelligence. . . . he should have known the probable consequences that would follow from the crushing of the bones and tissues of the foot.''

These two instances serve as well as any that could be selected to show the condition of the law with regard to this very important, yet very indefinite, matter. The cases, unfortunately, relate almost exclusively to the negative side of the question—i. e., as to what does not, rather than to what actually does, constitute the use of one's own best judgment.[2]

Miscellaneous matters.—An interesting question arises with respect to the medical or surgical malpractice of persons not licensed as physicians. A ''graduate optician,'' for instance, employs the title of ''doctor'' and ''eye specialist'' and declares to a patient, that he is a practitioner of medicine and that he can cure the patient's affection by means of a pair of spectacles. The patient is suffering from

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[1] 130 *N. Y.* 331 (1891).

[2] We might add, as being somewhat relevant to this rule, the legal principle that a physician who does not feel himself competent to treat a given case, should never, for that reason only, rely upon his judgment in that case, for the ''judgment'' rule has not for its object the protection of incompetency. In all cases where a physician feels himself to be incompetent, his duty is to recommend his patient to employ another doctor, whether specialist or general practitioner. If, however, the patient, after being thus recommended, is willing and desirous that the first physician continue in charge of his case, then the first physician is not liable (as suggested some distance *supra*) for anything but the very grossest negligence.

syphilis of the retina and optic nerve, and in consequence of the negligence of the graduate optician, he fails to receive the proper kind of medical attention, and his sight is destroyed. Is the optician liable? Again, a druggist treats an injured finger, pretending the while to the patient that he is a physician, and damage ensues as a result of the improper treatment. In all such cases the defendant is liable, precisely as if he were really a physician.[1] A still stronger case is that of Nelson v. Harrington[2] in which the defendant was a clairvoyant whose practice it was to place himself in a kind of trance, and, from that coign of vantage, to diagnose and prescribe for his patients. He had never declared himself to be a physician, but, on the contrary, had often asserted that he had no medical knowledge. Nevertheless, the judgment was against him both at the trial and in the higher court.

However, in this connection it is to be noticed that where the therapeutist or the surgeon does not profess to be a physician, and at the same time gives the advice or the service as a friend or neighbor merely, he incurs no liability. The leading case[3] upon this point possesses an especial interest for oculists. The defendant was a midwife, practising in Boston, Mass. She attended the mother of the plaintiff when the plaintiff was born, and, three days later, was shown one of the plaintiff's eyes, which seemed to be inflamed. The defendant declared to the plaintiff's mother that the trouble was "nothing serious, that it resulted from too much light," and she then "directed the witness to darken the room and to dip a linen cloth in water and place it on the child's eye." The room was darkened accordingly, and the application made. Next day the defendant again declared that the trouble was "nothing serious," and that she could cure it, and, this time, she made an application of rose-water. Two days after the first eye presented symptoms of disease, the second eye became affected. However, for two weeks the defendant came in twice daily and applied her washes to the child's eyes. The plaintiff's mother said to the defendant that she was alarmed about the child's eyes, and thought some competent physician should be called in. The defendant, however, replied that she need not be alarmed; that she, the defendant, could cure the disease; that she had cured with her washes several children so afflicted, and mentioned the child of one Mrs. Stevens, whose eyes were much sorer than the plaintiff's, and said she had cured the child's eyes with her washes; that the defendant also told her not to call in a doctor, saying that "the doctors spoiled the eyes of half the children," that "the doctors' washes

[1] Mathei v. Wooley, 69 *Ill. App.* 655.
[2] 72 *Wis.* 591.
[3] Higgins v. McCabe, 126 *Mass.* 13.

would burn the child's eyes out''; that she then told her to send for a fresh egg and have it beaten up with sugar, and wash the child's eyes with that,'' etc. The result was that the child became totally blind, and there was evidence from regular physicians to show that, had other and more powerful remedies been seasonably employed, they would probably have effected a cure. The court, however, said: ''The defendant was originally employed only as a midwife. . . . there was no competent evidence that the treatment of diseases of the eyes which might be developed in the child was embraced in the duties which the defendant undertook as a midwife. . . . A physician must apply the skill and learning which belong to his profession, but a person who, without special qualifications, volunteers to attend the sick, can at most be only required to exercise the skill and diligence usually bestowed by persons of like qualifications, under like circumstances. To hold otherwise would be to charge responsibility in damages upon all who make mistakes in the performance of kindly offices for the sick.[1]

A further miscellaneous matter, and one of much importance, is that, in some states, the defendant in a personal injury suit (to which variety of actions, of course, malpractice suits belong) is wholly devoid of power to oblige the plaintiff to submit to a physical examination for the purpose of determining whether or not his alleged injuries do actually exist, and whether, in case they exist, they are actually of as great extent and severity as the plaintiff has alleged. This would seem to be a very unjust holding, but it is actually the law in Illinois,[2] Texas, Montana, Delaware, Massachusetts, South Carolina, Utah, and also in the courts of the United States. To the contrary, however, hold the courts of Ohio, Kentucky, Georgia, Alabama, Missouri, Kansas, Arkansas, Michigan, Indiana, Wisconsin, Minnesota, Iowa, Washington, California, Colorado, Maryland, Nevada, Oklahoma, and North Dakota. The courts of New York formerly held against the

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[1] This case, however much one's sympathies may go out to the child, is nevertheless undoubtedly good sense as well as good law. One cannot, in fact, help recalling, in this connection, the words of Marshall D. Ewell (*Medical Jurisprudence,* p. 291): ''If a patient voluntarily employs in one art a man who openly exercises another, his folly has no claim to indulgence. The old Mahommedan case cited by Puffendorf with approbation is very much to the point: A man who had a disorder in his eyes called on a farrier for a remedy who gave him one commonly used upon his quadrupedal patients. The man lost his sight and brought an action against the farrier for damages, but the judge held that no action would lie, for if the complainant had not himself been an ass he would never have employed a horse-doctor.''

[2] I personally know two Illinois physicians (in independent practice) who are considerably out of pocket by reason of the fact that the court which heard their cases refused to compel the plaintiff to submit to an examination of his alleged injuries. The condition of the law on this point ought by all means to be regulated by statute in every State of the Union.

existence of the power, but the decisions of these courts have been overruled by a statute. There are also statutes to the same effect in Florida and New Jersey.

The courts which hold against the existence of the power, assert that the defendant, in case the plaintiff refuses to submit to a physical examination, may still find a sufficient protection against injustice in the privilege which his lawyer possesses of directing the jury's attention to the fact of the plaintiff's refusal. But, on this point, said Beck, J.:[1] "This position is not correct. The defendant is left to depend upon the inference of the jury, which might or might not have been exercised, instead of having the truth disclosed by direct and positive evidence. The law will not require it to depend upon such inference when it can afford the means of producing competent evidence upon the question in issue."[2]

Still another miscellaneous matter relates to the effect which a judgment rendered by a court of law in favor of a physician for his fee, has on the right of the patient, at some later period, to sue the physician for malpractice. It is a well-known fact that not infrequently when a suit is brought by a physician for his fee he is met by a counterclaim for malpractice. Then both matters are litigated together. If the jury decides that the physician has not been guilty of malpractice, then (provided the claim for fees be just and reasonable, not already paid, etc.), the court will give to the physician a judgment for his fees whereas if, on the other hand, the jury holds adversely on the question of the doctor's treatment, then not only does the doctor fail to secure a judgment for his fees, but, generally, he is mulcted in compensatory damages besides. But now suppose the doctor, when he sues for his fees, is not confronted by a claim for malpractice, and that he actually recovers a judgment against the plaintiff for the value of his services, and that, further, at some later date, the patient decides to sue the physician for malpractice. Is the suit for malpractice barred, or is it not?

The answer is that, in the vast majority of jurisdictions, it is, undoubtedly, barred. The great courts of New York, New Jersey, and West Virginia so hold in language clear and unmistakable.[3] Some

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[1] In Schroeder v. C. R. I. & P. Ry., 47 *Ia.* 375.

[2] For an extended discussion of this subject see an article by the present writer, entitled "May the Plaintiff in a Personal Injury Suit be Compelled to Exhibit His Injuries? If so, Under What Circumstances?" in the *Michigan Law Review*. Vol. I, Nos. 3 and 4, p. 193 and p. 277, Dec., 1902, and Jan., 1903.

It is interesting to note that the question in hand, though much adjudicated in America, has never arisen for decision in England.

[3] Bellinger v. Craigue, 31 Barb., 534; Gates v. Preston, 41 *N. Y.* 113; Blair v. Bartlett, 75 *N. Y.* 150; Dunham v. Bower, 77 *N. Y.* 76; Ely v. Wilbur, 49 *N. J. L.* 685.

courts make a distinction, however, between cases in which malpractice was actually pleaded as a defense, and those in which a judgment for the fees was taken by default, or where, though the defendant in the suit did actually appear, he nevertheless defended on some other ground than that of malpractice. Such courts hold that, in the latter two contingencies, the suit for malpractice is not barred. However, even in the great majority of states where the question has never as yet arisen in a court of last resort, the decisions of the courts of New York, New Jersey, and West Virginia, would, by reason of the great persuasive authority of these courts, almost certainly be followed.

A final miscellaneous question relating to the American law of malpractice is: May a valid judgment ever be rendered against a physician for malpractice in the total absence of expert testimony against his manner of treatment? The answer is, Yes, in certain very exceptional circumstances (namely where the existence of malpractice is patent to ordinary comprehension) such a judgment in the trial court would most undoubtedly stand. Just what the necessary circumstances are to enable a court to dispense with expert testimony in a malpractice case, is always a question of fact (not of law) but the following are typical and also actual instances of such circumstances, or rather sets of circumstances. In Moratzky v. Wirth,[1] an accoucheur permitted a portion of the placenta, 2 in. long by ⅔ in. in thickness, to remain in the uterus, by which neglect, as was alleged, the plaintiff suffered from septicemia, resulting in the loss of her leg. Held, that expert testimony was not necessary. In Lewis v. Dwinnell,[2] a physician failed to discover, as was alleged, an extensive perineal rupture. Held, that expert testimony could not be dispensed with. In Richardson v. Carbon Hill Coal Co.,[3] a physician who discovered a fracture of the femur 8 inches from the hip joint, did not discover, as was alleged, a coexisting and very manifest dislocation of the hip. Held, that expert testimony was not necessary. And, in Gedney v. Kingsley,[4] a physician, after the reduction of a Colles' fracture, put on the bandages so tightly that, as was alleged, great ulcers formed and the flesh sloughed off. Held, that expert testimony was not necessary. However, in James v. Crockett,[5] when a physician after repeated and careful examinations and a consultation with a competent fellow practitioner, did not discover a dislocation of the arm, it was held that expert testimony could not be dispensed with.

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[1] 67 *Minn.* 46. [2] 84 *Me.* 497. [3] 10 *Wash.* 648.
[4] 16 *N. Y. Supp.* 792. [5] 34 *N. B.* 540.

Legal considerations regarding malpractice in England.

The law of medical and surgical malpractice is, in England, very much the same as in America. In England, for instance, a physician (if not under obligations by reason of some official position) is never obliged to accept a case, no matter how great may be the urgency of the call or the importunity of the caller. But, a case once accepted, the doctor is under stringent legal obligations to continue in charge of that case—exactly as in America. In England, too, as in this country, the fact of gratuitous treatment does not alter a physician's responsibility for malpractice, nor is a contract with the patient, or with those who stand to him *in loco parentis*, of the very least validity. Such a contract is, as here, "opposed to public policy and therefore void."

The rule which regulates the *quantum* of skill, however, which a physician is supposed to bring to a case is different, in England, from what it is (or rather they are) in America. In America, as we have seen, there exist three rules: (1) That the physician must use such knowledge and skill as prevail in the particular locality in which he practises. (2) Such knowledge and skill as prevail in such localities generally. (3) Such as are possessed and used by highly educated physicians. The second rule, in America, we saw to be by far the most frequently adopted and enforced. Now, in England, the rule is that a physician must possess and use a "reasonable," or "ordinary," degree of knowledge and skill. Not only in the cases but in the text-books and cyclopedias, the words, "reasonable" and "ordinary" occur with great persistency. Thus, in Jones v. Fay (1865) "Any one who attempts to treat a sick person (otherwise than on sudden emergency) will be liable for any lack of such skill as an ordinary qualified medical practitioner possesses." Again, the *Encyclopedia of the Laws of England*":[1] "A medical practitioner, whether qualified or not, is responsible in a civil action for damages or a criminal prosecution for manslaughter, in case of the lack of reasonable care and skill. In civil actions everything depends on the interpretation of the qualifying word reasonable, and this is for the jury to interpret." The idea of locality, which seems to be the central, the controlling, notion in the American view of medical responsibility, possesses, in English law, absolutely no place whatever.[2] Indeed, in one case, that idea is expressly rejected. Thus, Garrow, B.: "It matters not whether the individual consulted be the President of the College of Physicians or the humblest bone-setter

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[1] 1900-09, Vol. IX, p. 125.

[2] Has not the small geographical area of England, together with the large geographical area of the United States, had much to do with the formation of this distinction?

in the village, he ought to bring into the case ordinary skill, care, and diligence."

Lately, however, and unfortunately, there has been developing a tendency on the part of High Court Judges to apply a stricter rule of accountability. This, it seems to me, is a step in the wrong direction undoubtedly, for the proper rule of accountability in a calling in which so much is, from the very nature of things, a matter of individual judgment in the individual case, should be that the practitioner is to be held responsible, not, as in Germany, for the lack of a very high degree of skill, but, as in France, for gross negligence or unskillfulness only. The trouble with the legal view both in England and in America (*a fortiori* in Germany) is that it regards the practice of medicine and surgery as something like, for instance, the industry of cabinet-making. Give to a cabinet-maker the proper materials and the proper tools, and, if he be neither unskillful nor negligent, he will make—and always make—for instance, a proper sort of chair. Then, too, the task of making a given kind of chair, for instance, is always and forever the same, and few, if any, competent workmen, would materially disagree as to how that particular variety of chair should be made. In the practice of medicine and surgery, however, the case is very different. In such a calling, a given variety of task is not always and forever the same. In fact, in such a vocation, the task, one is almost tempted to assert, is never twice alike. To a great extent, therefore, in such an occupation, the workman's individual judgment will always be of necessity engaged, and different workmen will, of course, ever be of very different opinions. Only the great settled governing rules and principles should always be adhered to—asepsis, for instance, and the necessity of ligaturing a large-sized wounded artery—the non-adherence to these, i. e., gross unskillfulness or gross negligence, might very properly be chastized by the courts. This, as said already, is the rule in France, and, again, may we not declare *avec raison* that they do really "order these things better in France?"

To hold a medical man responsible for a high degree of skill, is to insist that he shall, under legal sanction, possess a high degree of judgment. This, of itself, would be bad enough, for rules in the realm of judgment have but little application; but where, as in England and America, that high degree of judgment which is legally required, would have to be submitted to the further judgment of twelve often illiterate men, "assisted" by casual (instead of official) expert witnesses, who are sometimes not even licensed physicians, and concerning whose ability to "assist" in the matter in hand, the jury are about as incompetent to decide as they are of determining for themselves the medical ques-

tions at issue, then the medical defendant simply plays in a law court a game of chance and with the odds decidedly against him at that.

And, in England, even under such circumstances, the jury might, if they saw, or thought that they saw, occasion, assess *punitive,* as well as *compensatory* damages!

In England, as in America, one who poses as a specialist is responsible for a higher degree of skill than is a general practitioner. I have never been able to find on this point any ophthalmic cases, but it is, undoubtedly, the law as to specialism generally.

In England, too, one who copies an erroneous prescription, as, for example, from a text-book, or a journal article, ''adopts the error'' ''and is liable for any resulting injury.''

In England, however, a medical man is not liable for disastrous consequences which ensue upon the following of his ''mere friendly street-opinion.''

Legal considerations regarding malpractice in France.

The question of malpractice in civil cases, is, of course, never submitted to a jury in France, for the simple reason (as stated in the division on courts and basic legal principles) that, in France, there is never a jury in a civil proceeding. Thus, a civil suit for malpractice can be, and as a fact generally is, in France, conducted very quietly, and, in general, if judgment is not delivered against the physician, the public learns but little about the affair. In a common law country, such as ours, this phase of the French expert system could not, of course, be adopted, for, with us, there must assuredly be juries; but a person cannot help reflecting on the manifest justness and fairness of the French method to physicians who have been improperly accused of malpractice.

In France, moreover, as mentioned already, a physician is responsible only for ''clumsy mistake,'' ''gross imprudence or negligence,'' ''ignorance of those things which a man of the profession ought surely to understand.'' In the language of a text-book,[1] ''But, as soon as there arises a possibility of discussion as to the value and efficacy of the treatment which has been employed, upon the propriety of an operation which has been performed, as soon, in other words, as it becomes necessary, in order to determine whether or not a physician has been at fault, to trench upon questions exclusively technical and scientific, *when, in a word, the fault does not appear manifestly,*[2] the courts

[1] *Manuel Pratique de Droit Medical,* par Simon-Auteroche, Paris, 1908, p. 186.
[2] The italics do not appear in the original.

recognize of themselves their incompetence in this matter."[1] Thus it would seem that, in France, a physician is held responsible for malpractice only in that particular class of cases in which, as we have remarked heretofore, an American court delivers a judgment in the total absence of expert testimony.

In France, however, there exists no law providing that a physician's practice in any particular case be tested by the rules and principles of his own school.[2]

Legal considerations regarding malpractice in Germany.

In Germany, as previously remarked, a physician is responsible if he does not exercise "a high degree of skill," "the skill of a thoroughly educated physician."[3] The disadvantages and manifest injustice of such a standard of professional excellence have already been adverted to. However, it is only fair to redirect attention to the fact that, in Germany, a civil suit for malpractice is never tried before a jury, and that all the scientific points involved are generally investigated, or at least may be investigated, by a corps of medical experts who, as a rule, are really competent for their task. As a rule, the court-physician (*Kreisarzt*) functionates, and this without respect to the school of practice which the defendant has been following, or professing to follow. The defendant is permitted, however, to summon as experts a number of physicians of his own school, and this is occasionally done by the court on its own motion. As in America, general practitioners are often allowed to testify in matters which involve the skill of spe-

[1] Owing no doubt to the existence of this rule, malpractice cases are comparatively rare in France. In fact, I have never been able to find so many as a single instance in which the defendant was an oculist. A number of cases of a general nature can be found collected in Briand et Chaudé, *Manuel de Medecine légale,* Paris, 10th ed., Vol. I, p. 73 ff. Several cases (perhaps more accessible) are collected in Dubrac's *Traité de Jurisprudence Médicale et Pharmaceutique,* Paris, 1893.

[2] The scarcity of such rules in Civil Law countries is owing to the fact that, as stated in an earlier portion of this article, in such lands the subject of Evidence does not exist as a well-developed branch of jurisprudence.

[3] The law on this point was, until Jan. 1, 1900, landesgesetzlich (i. e., governed by state law) and hence was different in each of the Bundesstaaten, as is the case in America. On Jan. 1, 1900, however, with the entering into effect of the new "Civil Code," the matter in question passed under the federal law, and, therefore, all the decisions in force (so far as the decisions of courts are possessed of force in Germany) at the present time, are based on the following provision of that code: "Wer vorsätzlich oder fahrlässig das Leben, den Körper, die Gesundheit, das Eigentum oder ein sonstiges Recht eines anderen widerrechtlich verletzt, ist dem anderen zum Ersatze des daraus entstehenden Schadens verpflichtet. Die gleiche Verpflichtung trifft denjenigen welcher gegen ein den Schutz eines anderen bezweckendes Gesetz verstösst. Ist nach dem Inhalte des Gesetzes ein Verstoss gegen dieses auch ohne Verschulden möglich, so tritt die Ersatzpflicht nur im Falle des Verschuldens ein."—*Bürgerliches Gesetzbuch,* Sec. 823.

cialists. In fact the Kreisarzt is almost always, as a matter of course, a general practitioner. The right to bring an action for malpractice outlaws (*verjährt*) not until three years.

Another peculiarity of the German law of malpractice (though penal, instead of civil, in its nature) is that a physician is legally required to accept a case, if he is so requested, under certain circumstances, by a police-court or any of its representatives. The exact language of the requirement[1] is as follows: "Whoever in cases of accident or of common danger or necessity is requested by a Police Court or its representatives to afford assistance, and does not comply with the request, although he might so do without material danger to himself, is punishable by a fine not to exceed 150 marks or by imprisonment." This provision of the Penal Code is held to contemplate professional, as well as non-professional assistance. Being a part of the Penal Code, it is, of course, federal in its nature, i. e., nation-wide in its application.

With regard to experimentation, I can do no better than quote from Strassman:[2] "A procedure, merely because it is new and untried, cannot, only for that reason, be rejected as improper. Were such a principle indeed set in force, there could be no further progress in medicine. One can only require that a new and dangerous plan of treatment should be justified in advance of its employment by much consideration and reflection, by anatomical conditions, and by experiment on the lower animals. And one should be all the more ready to accept such a justification, the more obscure and atypical the disease." This opinion is characteristically German, insomuch as it clearly admits the necessity for scientific progress by means at times of human experimentation, and yet, nevertheless, lays down the only just conditions under which the performance of experiments on human beings could be permitted. It is decidedly in contrast to the rather vague, decidedly unscientific, and often wholly unjust requirements to be found in the law of America.

Legal considerations regarding malpractice in Italy.

Physicians in private practice in Italy are not obliged to accept a case either for examination or for treatment, excepting only in cases of great urgency, when immediate (though not subsequent) aid and assistance is absolutely obligatory on the part of every physician.

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[1] §360, Ziff. 10, Str.-G.-B.

[2] *Lehrbuch der Gerichtlichen Medizin*, Stuttgart, 1895, S. 545. The high degree of authority conceded to text-books by the German courts has already been adverted to.

Physicians, on the other hand, employed in the official medical sanitary service of the various communes of the Kingdom, are obliged to accept all cases that fall within the scope of their employment. A very extensive and voluminous law [1] has been enacted with regard to these official physicians, regulating their appointments, service, compensation, responsibilities, and participation in the benefits of an elaborate pension system.

A non-official physician, when he has once accepted a case, becomes, of course, responsible for the exercise of diligence and skill while in attendance on such case. His civil liability is regulated not by any special provisions, but by the general laws of the Kingdom, contained in the Civil Code. These laws run as follows:

1151. Any act of a person productive of damage to another, imposes on such person the obligation to indemnify for such damage.

1152. Every person is responsible for the damage he has caused, not only by his act, but also by his negligence or imprudence.

It is, of course, extremely manifest that the law as laid down by article 1151 would, if literally applied, be of so great rigor as absolutely to prohibit the practice of medicine, surgery, and obstetrics in Italy. The courts, however, have, in practice, very much mitigated the severity of the law (as applied to physicians) being, in fact, in this regard, almost, if not quite, as lenient as are the courts of France. Thus, for a single example, the Court of Appeal of Bologna has said that ". . . professional error is pardonable in the liberal pursuits when . . . there is no gross negligence or ignorance of clear rules universally recognized and declared.[2] So also Giorgi: [3] "If *errare humanum est* there exists no field in which this sad truth is more applicable than in the exercise of certain offices or professions, which furnish by their very nature a continued theme for controversy and for doubt. The difficulty of tracing out the elements of fact which should constitute the basis of any expert judgment; the variety of systems and of schools; the occurrence of unexpected events; the vast number of the causes which can influence the result in any case, render excusable any such errors as do not depend on the violation of a clear and certain precept or the neglect of treatment which is evidently necessary."

A very peculiar circumstance connected with the matter in question, is that, in Italy, no civil responsibility ensues till after a criminal

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[1] That of Feb. 25, 1904, entitled *Sanitary Assistance, Hygienic Vigilance, and Hygiene of the Communes of the Kingdom.*

[2] Sent. 2 maggio 1902, Filangieri 1902, 862.

[3] Quoted in the *Enciclopedia Giuridica Italiana,* Vol. X, p. 328.

prosecution has first been brought against the physician and successfully. I know of no such law in any other country.

Another peculiar restriction, if such it may be called, relates to the matter of experimentation. In Italy, in addition to the usual restrictions (preliminary experimentation on the lower animals, some justifiable theory of benefit to accrue to the particular patient who is made the subject of the experiment, etc., etc., as in other countries) it is suggested, in addition, by an eminent Italian legal authority, that the experimenter "before he deduces the innocuousness to man [of the proposed method] from the frog, the rabbit or the dog, ought to have tested the method on himself." [1] This would seem to be a difficult matter indeed to accomplish, in case the experimenter did not happen to possess in his own person a case of the particular malady in question. It would even be extremely difficult for the experimenter to test upon himself the matter of dosage, in case the patient was a child. The restriction might, however, under certain circumstances, very logically be made a condition precedent of the performance of new operations or the administering of new remedies.

In Italy no higher degree of care and skill is legally required of a specialist than of a general practitioner in the same field.

Furthermore, a judgment for malpractice against a physician can be rendered in that country, even in the total absence of expert testimony, provided the existence of malpractice is patent to ordinary apprehension—in other words is not dependent on technical medical or surgical rules and principles.

This completes our discussion of the subject of malpractice with respect to its legal side.[2] We will next take up the

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[1] "* * * diversamente il medico risolverebbe i problemi scientifici cimentando la salute e la vita altrui, risparmiando sè stesso, ed allora il malato diventerebbe la bestia da laboratorio, e questa sarebbe seria disonestà professionale." *Enciclopedia Giuridica Italiana,* Vol. X, p. 331.

[2] The following extracts from the *Code of Hammurabi, King of Babylon* (about 2250 B. C.) translated by Rob't Francis Harper, Ph. D., would seem to possess especial interest for oculists, because without doubt they constitute the oldest extant legislation concerning ophthalmology:

"196—If a man destroy the eye of another man, they shall destroy his eye.

"198—If one destroy the eye of a freeman or break the bone of a freeman, he shall pay one mana of silver.

"199—If one destroy the eye of a man's slave or break a bone of a man's slave, he shall pay one-half his price.

"215—If a physician * * * open an abscess (in the eye) of a man with a bronze lancet and save that man's eye, he shall receive ten shekels of silver (as his fee).

"216—If he be a freeman, he shall receive five shekels.

"218—If a physician * * * open an abscess (in the eye) of a man with a bronze lancet and destroy the man's eye, they shall cut off his fingers.

"220—If he open an abscess (in his eye) with a bronze lancet, and destroy his eye, he shall pay silver to the extent of one-half of his price."

B—Medical and Surgical Considerations Regarding Malpractice.

Under this head will be narrated typical and otherwise interesting cases of ophthalmic malpractice which have been the subject of suits either actual or contemplated. Excluded, however, will be all cases which have undergone decision in courts of last resort, for the reason that the most important of such cases have already been discussed under "Considerations Legal."

The largest proportion of all the suits and claims for malpractice that ever confront the ophthalmic surgeon arise from strabismus operations.[1] The reason is obvious. The strabismic eye is almost always defective in its vision to begin with, and, if the oculist does not observe the precaution to explain and even to demonstrate absolutely beyond cavil the fact of defective vision in each particular case in which he is about to operate, then, after the operation, when the patient, or his relatives for him, are curious about the exact results, the undesirable fact of complete or partial blindness comes out, and the surgeon is blamed for the defective condition of the sight. Already, under the heading of "Considerations Legal," we have seen that several cases of malpractice suits following strabismus operations have even reached the courts of last resort. Here is another instance. An oculist of the highest standing (scientifically at least) did a double internal advancement for a girl of eleven years. He had made a record of the case but had failed to set down the vision of either eye, nor had he directed the parents' attention to the fact that the vision in both of the eyes was decidedly defective. No doubt the operation was correctly performed, but the immediate effect was undeniably an over-correction of six or eight degrees. This instigated the parents of the child to do considerable investigating into the condition of the eyes on their own account (in which proceeding they were ably assisted by a graduate optician) and at last they arrived at the conclusion that the distinguished oculist had ruined the eyes of their child. They then set up a claim for damages against the operator, who, very properly, refused to pay. In search of expert evidence they returned to two eye specialists (practising independently of each other) by whom the child had been examined before they had taken her to the man by whom the operation had been performed. Each of these oculists had, happily, made a complete record of the case, including, of course, the vision of

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For the rest of this remarkable code, see The Code of *Hammurabi, King of Babylon*, by Rob't Francis Harper, Ph. D., 2d ed., 1904, Chicago, Callaghan & Co.

[1] So at least according to a collection which I made for many years of newspaper and medical journal clippings which related to malpractice suits, as well as also according to many notes which I made of various cases that either fell within my personal experience or came to my ears by reliable report.

each eye, and very soon the parents were convinced that their claim for damages was unfounded. A laughable feature of the affair was that, when their child had been taken to the last of the three oculists (that one who had done the operation) and by him been examined, he had expressed (after the fashion of some men otherwise sufficiently worthy) several very decidedly unflattering views of the professional attainments and judgment of the two oculists who had been consulted before him. Afterwards, taxed with these ungracious opinions, he, though contritely enough, admitted that he had made them.

I have also known of other instances in which the defective sight of a crossing eye has given rise to malpractice suits, or claims, because, as in the case narrated, the surgeon had neglected, before the operation, to impress the patient, or those responsible for him, with the actual condition of his sight.

Deep retraction of the caruncle after a strabismus operation has been, in one instance, the ground for a claim for malpractice. The operation had been performed by a traveling charlatan who was one of the few of his class that I have ever known to be made the subject of a claim, or suit, of this sort.

Next to strabismus operations, as a fertile field for the growing of malpractice suits, come the various foreign-body cases; foreign bodies in the cornea, foreign bodies in the aqueous, foreign bodies in the iris or the lens, foreign bodies in the vitreous, and, finally, foreign bodies in the posterior wall of the eye and even in the orbital fat. Foreign bodies in the cornea, not infrequently (and even after the most aseptic removal) leave infection of that membrane with consequent ulceration and all the deplorable sequelæ. In such cases, just because the offending substance was perhaps extremely minute, the patient jumps to the conclusion that no such serious consequences would, or could, have followed, had not the treatment been improper.

Small, hard bodies flying with great velocity sometimes perforate the cornea, and then, if the patient is working in comparative darkness, as often happens in the case of miners, the pupil is, of course, rather widely dilated and the tiny projectile will lodge perhaps in the periphery of the lens, and, later, when the surgeon examines the eye, as he usually does, with a very strong light, he contracts the pupil and prevents himself from seeing the offending substance. I was told of a case in which an eye was lost, or was said to have been lost, in this very manner, and which formed the ground for a successful claim for damages.

I had personal knowledge of a case which formed the ground of a claim for damages in which a piece of steel was supposed to have

entered an eye very deeply. The attending oculist suggested that the eye be submitted to the X-ray for the purpose, of course, of deciding whether or not there was a foreign body present, and, further, if present, its precise location. The patient, however, refused to have the skiagraph made, first, because of what she regarded as ''the very great expense which such a proceeding would necessitate''; and second, because she had heard of people being injured by the action of the Roentgen ray. At the time when the case appeared before the oculist, there was not to be seen a breach of surface anywhere, nor even a trace of any former breach. The aqueous was dark with blood, and so an ophthalmoscopic examination was impossible. The surgeon combatted the inflammation for several days, and then the patient sought another oculist. The second practitioner, after several days of treatment, discovered, whether by skill or by a lucky chance, the offending substance, and removed it with a magnet. Unfortunately, this second oculist permitted to escape him certain remarks which reflected on the skill, or judgment, of the first practitioner, and the result was a claim for damages. The patient brought with her to the first physician's office, her two main witnesses, but these, fortunately for his reputation, refused to stand by the claimant's allegations. The result was that no suit was ever brought.

Ophthalmia neonatorum, too, presents its quota of claims for damages against the attending physician, and, strangely enough, the disgusting and discreditable character of the disease does not suffice in every instance to keep the claim out of court. I know of a case in which a general practitioner was sued for allowing the disease to occur without the slightest effort to prevent it. He had known at the time of delivery that the mother had recently suffered from gonorrhea, and, in fact, himself had treated her for that disease up almost to the very day of labor. The doctor was given an opportunity to settle for a small sum, and, very wisely, he accepted the opportunity.

Glaucoma, strangely enough, considering the frequency with which the disease is mistaken, and treated for iritis and conjunctivitis, has seldom been the subject of a suit for malpractice. I know, however, of two cases. One was where a family physician had treated a case of this disease for a very short time by means of atropin and adrenalin, with the result that the patient was very nearly blind, when, with considerable indignation, she left him for an oculist. This oculist, though he smoothed the matter over for the family practitioner, nevertheless recommended, as was no doubt his duty, an immediate iridectomy in both eyes. But the operation was indignantly refused. The patient called again on her family practitioner, who strongly stayed her up in

her contention that an operation was entirely unnecessary, and who also bade her seek the services of another oculist. The second specialist, being a man of careless speech, said something which aroused the patient's suspicion, and the result was a claim for damages against the family practitioner. The matter was somehow settled.

The second case was where a family practitioner mistaking (as has so often happened, sometimes without the practitioner's fault) glaucoma for iritis, dispatched his patient to a pharmacy with a prescription calling for cocain with atropin. The result was blindness for the patient, and a suit for the doctor. The prescription was on record, and the fact of absolute glaucoma indisputable. The claim was settled out of court by the payment of a small sun.

An oculist of excellent reputation and undoubted ability, being rushed with work, performed a pterygium operation without sufficient consideration of all the factors in the case. It so happened that the patient had dacryocystitis on the same side as that on which the operation was performed, and the result was a panophthalmitis. A claim followed, which, in some way, was settled out of court.

Now and then a cataract operation gives rise to a suit. I was told by a friend, an oculist, that, after a simple extraction performed by him, he was sued because the operated eye had recovered only half its vision. The doctor, a man of much ability and the very greatest caution, knowing exactly what his rights were, would not scare at all, and the suit was abandoned.

I know of an oculist who had a case of trachoma in the cicatricial stage, complicated with pannus and numerous corneal ulcers. The patient made an excellent recovery, so at least the oculist thought, but the patient thought differently, or at least professed to do so, and made a claim for damages. The oculist refused to pay the claim, and the patient sued, alleging total blindness. Not long after, and before the case had arisen for trial, the plaintiff fell from a tree in which he was picking cherries, and sustained a fracture of the occipital bone. Shortly afterward he died.

Another illustrative case was this: A miner was struck in the eye by a piece of flying coal. That the injury was severe was shown by the great contusion of the lids and the formation, subsequently, of a deep and angry ulcer on the cornea. In order to cure the ulcer it became necessary to perform a paracentesis of the anterior chamber, and this procedure was carried out with the very greatest caution. The patient got well, and had absolutely perfect vision—for a time at least. In the course of a few weeks, however, a traumatic cataract appeared, and for this the operation was supposed to be to blame. On being informed,

however, that the blow inflicted by the coal was itself entirely responsible for this late manifestation, the miner, an exceptionally reasonable man, was altogether satisfied.[1]

Even refraction work is not devoid of the malpractice danger. I had a clipping of a case which related that an oculist, a man of merit and means, had been subjected to a suit because an optician had informed the plaintiff (and afterwards been sustained in his contention by an educated oculist) that one of his eyes had suffered an extensive detachment of the retina because of a badly fitting lens. In another case, a claim was made against a meritorious oculist because, as was alleged, a badly-fitting pair of lenses had produced a pterygium and "granulated" eyelids. Here is still another case connected with refraction work. A lady, aged 20, complained of headache and rapid ocular fatigue. Test-lenses and ophthalmoscope declared the refraction normal. Into each eye was instilled thrice daily for three days a 1 per cent. solution of atropin. Then the test-lenses and ophthalmoscope revealed four dioptres of hypermetropia. Glasses were prescribed, and she suffered no longer from headaches or from ocular fatigue. Nevertheless, she evinced intense dissatisfaction because, her ciliary muscles being now relaxed—as, of course, they ought to be—she was, as she alleged, without her glasses "blind." She admitted that, with her lenses, she saw as well as anyone, and had neither headache nor ocular fatigue, but all this very evident improvement was as dust and ashes beside the over-whelming and heart-rending fact that, without her glasses she was "blind." All the proffered explanations made by the oculist were unheeded, and, indeed, appearances, however unjustly, were much against the doctor. Legal proceedings were discussed, and it was only through the influence of the general practitioner who had referred the case to the specialist, and who, by the way, was a relative of the plaintiff, that legal action was averted.

I have the record of a number of other cases, but these are not especially illustrative. However, I cannot leave this subject without a bit of moralizing—for which, I trust, the great importance of the sub-

[1] Here it may not be amiss to state that the possibility of the formation of a late traumatic cataract should always be explained to patients suffering from ophthalmic trauma, both when the case is taken and again when the patient is discharged. The time consumed is well invested, nor need the patient be affrighted unduly by such an advance explanation, for the matter can be represented (as, in fact, it ought to be) as merely the remotest possibility; and then, should the unexpected happen, the physician is safe.

It is a rather suggestive fact, at least from the doctor's viewpoint, that the number of malpractice suits which a physician is liable to encounter, stands in a direct ratio to his ability to make a judgment "good." In other words, such suits seem to bear relation of some sort to the doctor's financial ability rather than his scientific inability.

ject involved will provide a sufficient excuse. It will have been observed, in nearly all the cases just narrated, that the real, the fundamental, the underlying cause of the suit, or at least of the claim, for damages, was (either by intent or otherwise) another doctor. This fact should give us pause. There is also another fact to be observed in nearly all these cases which constitutes a ground for very serious consideration. And that is this: The defendant in nearly every instance, was an unusually competent man. I must really dissent from an opinion quite recently expressed by an able lawyer in an American surgical system,[1] which runs thus: "On the other hand, the earnest, diligent, well-read, scientific surgeon, who has a library and reads his journals, who uses instruments of precision, who observes approved methods; the 'good,' 'reliable' surgeon, who knows how to reduce dislocations, adjust fractures, tie arteries and treat wounds, to supervise the use of anesthetics, and to prescribe or conduct the after treatment, who, after a careful examination, uses his best judgment and skill in operating, who is exacting as to prior assent, and who instructs nurse and patient as to conduct, while not immune, has little to dread in the courts." This, no doubt, is the strictly legal (also, perhaps, the strictly public and general) view of the matter. But doctors, to whom the subject of medical and surgical merit and demerit is not a sealed, but an open book, are perfectly aware that there could hardly exist a greater mistake than that expressed in the opinion above-quoted. Quacks, as a mere matter of absolute truth, are very seldom sued. On the other hand, the greatest surgeons in the country, subject as they are to continual jealousy, and receiving, as they do, many of the hardest and most inveterate cases, as well as a very high proportion of the most dangerous, are almost continually "in hot water." An excellent ophthalmic surgeon of my acquaintance has been sued, or threatened with suit, no less than seventeen times. And, though no judgment was ever rendered against him, the worry has hurt him and aged him vastly more than all his work. Moreover, in nearly every instance the cause of his trouble was either the malice or the thoughtlessness of a fellow practitioner. The surgeon I have in mind was probably not really to blame in any single instance. And equally good men have not been quite so fortunate as he in the outcome of their suits. All this sad state of affairs with regard to medical and surgical malpractice could easily be different. In the first place, the French standard of responsibility should be adopted everywhere. The physician should be held accountable only for violations of clearly estab-

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[1] Hampton L. Carson, in Keen's *Surgery,* 1909, Vol. V, p. 1180.

lished principles—in a word, for gross negligence or gross lack of skill. Furthermore, expert evidence, in all these cases, should be really expert. Then, too—and this perhaps is the most important matter—every physician who examines a patient that has been to another doctor, should be cautious in every word that he utters. Or, rather, he should be more than merely negatively cautious, he should be positively kind. He should do, in short, exactly as he would be done by. If every physician would only observe this rule—the golden rule in a professional aspect—he would never discover an occasion to regret it, whether he practised in America, in England, in Germany, France, or Italy, or, indeed, in the remotest portions of the earth.

With regard to the jurisdiction of United States courts in negligence cases, I am greatly indebted to a private letter from Judge A. L. Sanborn, federal judge for the Western District of Wisconsin.

With respect to foreign law, I desire to acknowledge my obligations to the following gentlemen, not only for references to useful literature, but, in a number of instances, for full answers to specific questions:

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Legislation, Ophthalmo-sanitary, in various countries. See **Ophthalmology, Legal relations of,** in the last third of the section.

Lehman, Georg Karl Heinrich. A well-known Danish ophthalmologist. Born Oct. 27, 1815, at Copenhagen, he there received his medical degree in 1846, his dissertation being "De Rationibus Physiol. et Pathol. Humoris Aquei Oculi Humani." He published a number of ophthal-

mologic articles in Danish, German and English journals, founded the first ophthalmic hospital in Copenhagen, and was, for years, physician to the Copenhagen Blind, Deaf and Dumb Institution. He died Sept. 24, 1890.—(T. H. S.)

Leib. (G.) Body. Abdomen.

Leibhaftig. (G.) Corporeal.

Leiche. (G.) Corpse.

Leichenbefund. (G.) The state of things found on post-mortem examination.

Leiden. (G.) Suffering; pain; ailment.

Leiomyoblastoma. See **Leiomyoma.**

Leiomyofibroma. A tumor with leiomatous, myomatous, and fibromatous elements.

Leiomyoma. A rare tumor formed of unstriped or smooth muscle fibres as a fundamental element, presenting by its texture a more or less pronounced analogy with smooth muscular tissue, and seated in the interior or in the neighborhood of an organ made up of that tissue. It is generally malignant. Van Duyse has described (*Archives d'Ophtal.,* p. 13, Vol. 31, 1911) one of these neoplasms affecting the iris.

Leiomyosarcoma. A sarcoma containing large spindle-cells of unstriped muscle.

Leishman's method. A method for determining the phagocytic index by adding the bacteria to a leucocytic cream from the patient's blood, and, after incubation, counting the number of bacteria within the phagocytes.

Leishmania. A name (after Sir William Leishman) proposed for a genus of parasitic protozoa. In the human animal the organisms appear as small, oval or pear-shaped bodies with both a nucleus and a micronucleus. Cultivated they assume the shape of flagellated organisms.

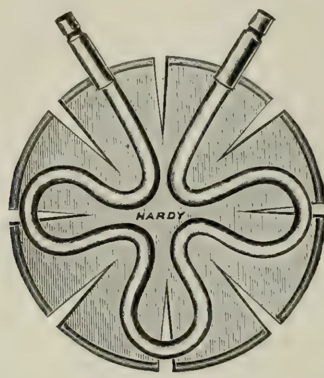
Volpino (*Centralbl. f. Bakteriol. und Infectionskr.,* Vol. 60, p. 91, 1911) has produced experimentally an infection of the cornea with *Leishmania infantum*, while Lemaire, Sergent and L'Heritier (*Bull. Soc. de Path. Exot.*, Vol. 7, p. 193, 1914) have more recently reported a spontaneous specific keratitis occurring in dogs that have contracted a Leishmanosis in other than experimental ways. Histologically, the corneal condition closely resembles a true parenchymatous keratitis, except for the fact that the causative organisms were found within the cells. The disease left permanent opacities that were characteristic enough to allow of recognition of the condition of Leishmanosis.

Leiste. (G.) Band; border; channel; groove.

Leistungsfähigkeit. (G.) Capacity.

Leiter. (G.) Conductor.

Leiter's coil. This well-known device for the local application of either heat or cold forms an effective method of either raising or reducing the temperature of the eye. See the figure. A description of the coil will be found on p. 5725, Vol. VIII of this *Encyclopedia.*



Leiter's Lead Coil for Cold or Hot Applications.

Leitung. (G.) Conduction.

Le lieu aveugle. (F.) The blind spot.

Lema. (L.) Of old writers, the dried secretion of the Meibomian glands; also a discharge from the eye.

Lema palpebralis. (L.) See **Lema.**

Lemaleus. (L.) Affected with lema.

Leme. (L.) Lema.

Lemon essence. In the early days of Columbian spirits' poisoning some manufacturers of essences, Jamaica-ginger, etc., were in the habit of substituting that form of wood alcohol for grain spirits. Dunn (*Virginia Med. Semi-Monthly*, 25, Jan., 1900) gave an account of a 19-year-old boy who drank two bottles of Jamaica-ginger with lemon essence. This was followed by the usual symptoms—optic neuritis and blindness—as was the case in a number of other instances of methylated essence poisoning throughout this country. See **Toxic amblyopia.**

Lemon juice. See **Acid, Citric.**

Lemosity. Lippitudo.

Lemotes. (L.) A name for lippitudo.